CENTRAL MAUI WASTEWATER RECLAMATION FACILITY STUDY

Maui, Hawaii

August 12, 2005

Prepared for:

County of Maui
Department of Public Works
and Environmental Management

Prepared by:

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Cont'd)

TABLES

FIGURES

TABLE OF CONTENTS
(Cont'd)

REGULATORY ASSESSMENT REPORT

TABLE OF CONTENTS
(Cont'd)

FINANCIAL PLAN

TABLE OF CONTENTS
(Cont'd)

TABLE OF CONTENTS
(Cont'd)

APPENDICES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

I. Background

In order to address the findings and recommendations in this study, the County of Maui would need to incorporate the Central Maui Region's wastewater system requirements in planning for the region's long-term future. Timely decision-making today will establish future direction in how the County will meet the region's wastewater treatment and disposal needs for the next 20 to 30 years.

The existing Wailuku/Kahului Wastewater Reclamation Facility (WWRF) has undergone two major capital upgrades to increase treatment capacity, operation reliability, and tsunami-proofing within the past 10 years. Based on this investment, the WWRF is the fundamental component that should be considered in exploring alternatives and deciding on an approach to meet future wastewater treatment and disposal requirements for the Region.

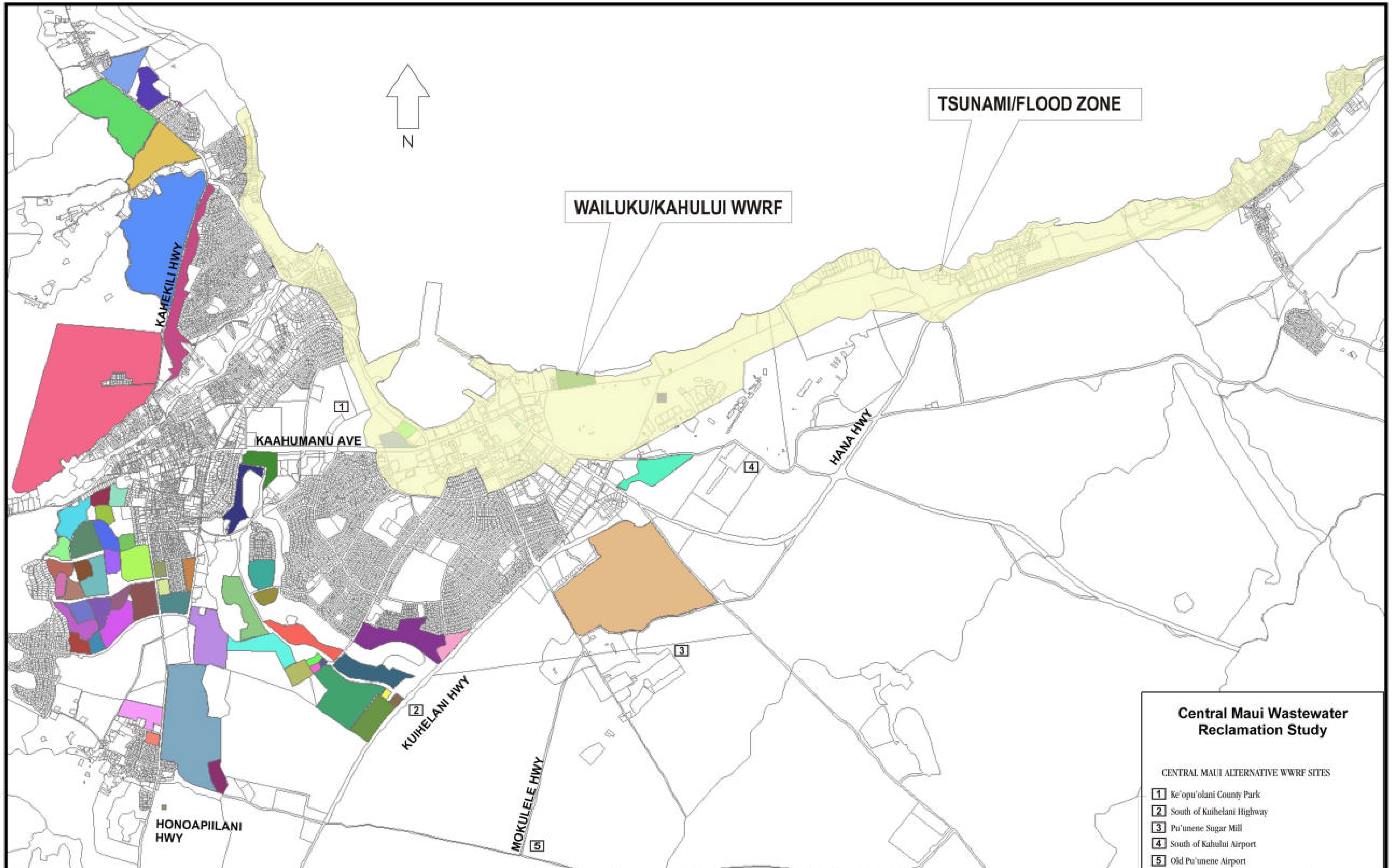
The major issues facing the County of Maui at the WWRF include the following:

- Available treatment capacity
- Accelerated shoreline erosion
- Potential tsunami impact

To address these issues, the County of Maui has undertaken this study to identify treatment and disposal alternatives for the future. A number of combinations of treatment and disposal alternatives were considered and evaluated in this study. In conjunction with this effort, ongoing shoreline erosion problems at the facility and the remaining concerns dealing with a potential tsunami impact on the facility were also reviewed. . Figure 1. highlights the proposed Central Maui development areas, the location of the existing Wailuku/Kahului WWRF and the Tsunami/Flood Zone. This figure also indicates expansive growth is planned for the Wailuku region over the next 15 years.

These issues are not new to the County of Maui. Previous studies have been undertaken through the years, with various recommendations being made. This study updated the information gathered in these previous studies by developing a comprehensive list of treatment and disposal alternatives that will meet the future wastewater infrastructure requirements for the Region and fulfill the objectives of the Maui County General Plan and the Wailuku-Kahului Community Plan.

Figure 1


TSUNAMI/FLOOD ZONE
WAILUKU/KAHULUI WWRF
N
KAHEKILI HWY
KAAHUMANU AVE
HANA HWY
KUIHELANI HWY
MOKULELE HWY
HONOAPIILANI HWY
1
2
3
4
5
Central Maui Wastewater Reclamation Study
CENTRAL MAUI ALTERNATIVE WWRF SITES
1 Ke'opu'olani County Park
2 South of Kuihelani Highway
3 Pu'unene Sugar Mill
4 South of Kahului Airport
5 Old Pu'unene Airport

II. Study Objectives

The objective of this study was to identify and develop a comprehensive list of conceptual treatment and disposal alternatives that can meet the Region's future wastewater infrastructure requirements. In developing the study, involving and understanding the community's concerns played a critical role in concept development. The project scope of work was organized to address several primary objectives:

- Assure effective and meaningful community participation
- Establish capacity of existing wastewater infrastructure
- Determine effluent disposal and bio-solids disposal options
- Define shoreline issues
- Define existing wastewater reclamation facility structural issues (i.e. The ability of the major facility structures to withstand a tsunami.)
- Develop alternatives for meeting future wastewater infrastructure needs
- Initiate a public outreach program
- Evaluate financial planning alternatives

Incorporating the values and evaluation criteria developed with the community, the comprehensive list of alternatives was filtered to eleven plus a No Build/Do Nothing alternative using a process that included an evaluation matrix and weighting factors. The result of these efforts is essentially a long-range master plan for the Central Maui wastewater system.

As a side issue to addressing one of these primary objectives dealing with the "Establishing the Capacity of the Existing Wastewater Infrastructure", our findings revealed that new wastewater capacity would be triggered in 2029 based on the wastewater demand forecast developed and presented in this report. Figure 2 displays the wastewater treatment demands for the Region through 2030. The graph also highlights the regulatory planning and design requirements for the Region based on wastewater treatment demands. A Facility Plan must be initiated in 2008 and design in 2017 for additional treatment capacity. While this new wastewater capacity demand is 25 years into the future, there is value in presenting the selected treatment alternatives to address the other major WWRF issues of mitigating tsunami and shoreline erosion impacts at the WWRF. To illustrate this point, a Project Implementation Schedule is provided in Figure 3, to identify the various tasks that would need to be completed and the timing for each task. These are summarized as follows:

- FY 2007: Implement and maintain shoreline erosion mitigation measures.

- FY 2007: Corrective measures for those treatment components that have not previously been evaluated in terms of tsunami-proofing.

- FY 2008: (75% of the existing facility capacity.) Initiate the Facility Plan/ Preliminary Engineering Report phase of the project.

- FY 2011: Initiate EA/EIS process.

- FY 2014: Initiate Land Use Entitlements.

- FY 2017: Initiate Permitting and Design. (90% of the existing facility capacity.)

- FY 2019: Initiate Construction. (Construction can start anytime after FY 2019, with a scheduled completion by FY 2029. An early start date would give the County flexibility to address any unforeseen increase in demand that may result in the existing WWRF reaching its design capacity earlier than the FY2029 projected date.)

Figure 3 indicates that the time needed to implement whichever alternative is selected will be time consuming and that the initiation of this process at this point in time is critical.

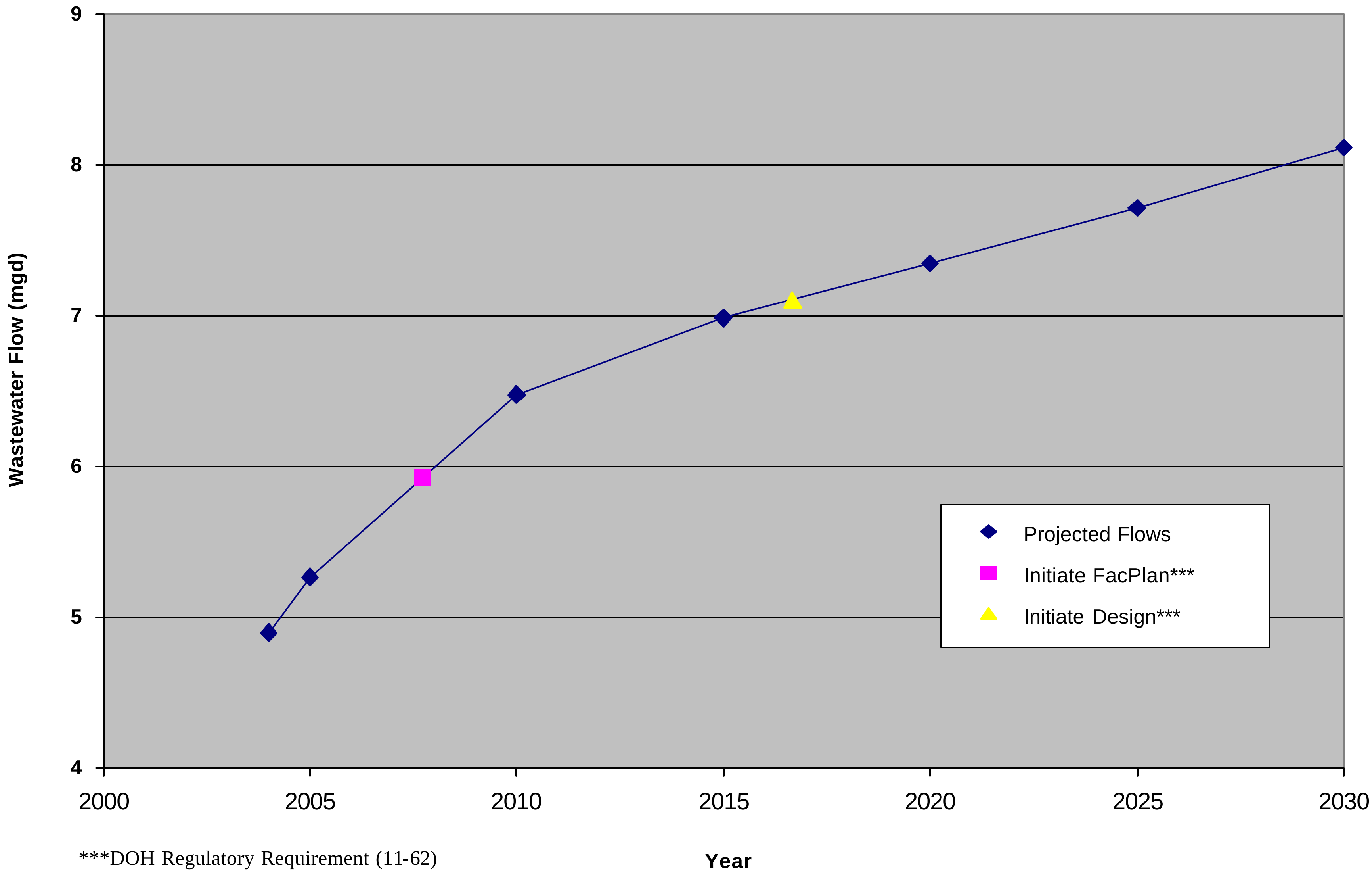
III. Report Contents

This report was prepared by Austin Tsutsumi and Associates, Inc. (ATA) and its consultant team comprised of firms specializing in addressing the project objectives. The consultant team's participation is reflected in the major report sections of this study as follows:

- <u>Community Participation</u>: Effective and meaningful community participation was a key component of this study. Earthplan, a Honolulu based community planning and communications firm, prepared the strategy for community participation program and conducted the seven core working group meetings that were held during the first 13 months of this project.

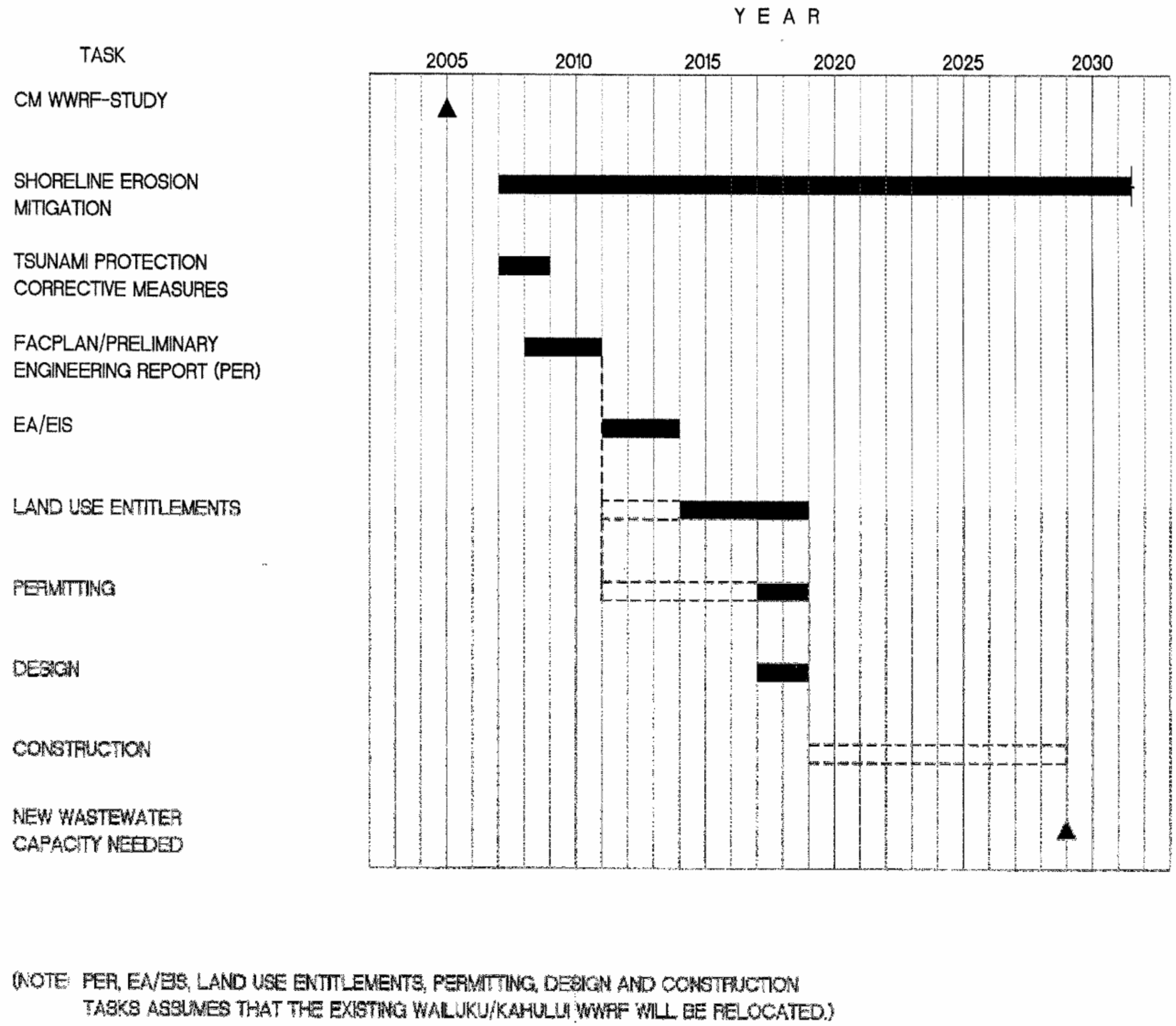
- <u>Existing Central Maui Wastewater Infrastructure and Alternative Wastewater Capacity Demand Alternatives</u>: The evaluation process considering both existing and new alternatives to meet future wastewater capacity demands served as the foundation for decision making and scheduling of future infrastructure improvements. Brown and Caldwell, a Maui based environmental consulting engineering firm and Austin, Tsutsumi & Associates, Inc. (ATA), a Maui based civil/environmental consulting engineering firm were tasked to undertake the alternatives evaluation.

Figure 2. Central Maui Region
Wastewater Treatment Capacity Demand Forecast



***DOH Regulatory Requirement (11-62)

Figure 3. PROJECT IMPLEMENTATION SCHEDULE



- Regulatory Assessment: A component of this study involved a general overview of State and County plans, policies, land use controls, and environmental laws, which will need to be considered in the evaluation of future wastewater treatment alternatives. Munekyo and Hiraga, Inc., a Maui based planning and permitting firm, assessed regulatory requirements relative to Central Maui's wastewater system.

- Financial Planning: An important component of this study was to determine the financial impact of the recommended improvements on the users and how this resulting financial impact will be met. This effort was undertaken by Western Financial Group, a Portland, Oregon based financial planning firm.

- Shoreline Evaluation: A critical constraint associated with the alternatives analysis is that many of the County's beaches are eroding, including the shoreline fronting the Wailuku/Kahului WWRF. There are concerns regarding the current erosional trends on the existing and any future plant expansions. Moffatt & Nichol Engineers, coastal engineers out of Long Beach California, was tasked to evaluate this component of the project.

- Existing Central Maui Wastewater Reclamation Facility Structural Evaluation: The remaining critical treatment components that are exposed to destructive tsunami impacts within the existing WWRF were evaluated in terms of their structural soundness to withstand the impact of a tsunami event on this facility. Nagamine & Okawa Engineers, Honolulu structural engineering firm was tasked to evaluate these structures.

IV. Core Working Group (CWG)

A key component for this study was community participation. The County wanted to ensure that community principles and values would shape and evaluate the alternatives. It was recognized that community values play a major role in future actions related to the wastewater system. In addition to meeting existing and future community wastewater needs, any future action will have implications related to community financial impacts, environmental impacts and other ramifications.

To ensure meaningful and broad-based participation, the project team convened a project Core Working Group (CWG). The CWG was a diverse group of community members who collectively reflect a broad cross section of community values. Complementing the CWG members were resource members which included public officials who have information or may be affected by the wastewater system.

The CWG actively participated in seven scheduled meetings over a 13-month period. The meetings were designed to help CWG members understand the project, explore options, advise the project team on the criteria, and review alternatives. During the course of this 13-month period, the CWG developed guiding principles that served as fundamental statements of community values that guide discussions and actions on this project. To explore a wide range of options within the context of community values, the CWG was instructed on the use of scenario planning, a tool often used by corporations and communities to think through possible future scenarios.

To carry out the various strategies within these scenarios, the CWG and the project team developed several alternatives that ranged from building a new centralized facility to expanding the existing plant. These alternatives were:

- Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns
- Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Construct satellite WWRFs for future capacity
- Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Develop smaller individual wastewater systems for future capacity
- Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku / Kahului WWRF
- Build new WWRF for future flows and relocate existing Wailuku / Kahului WWRF away from tsunami and erosion zone
- No action / no build (No disposal option for this alternative.)

These alternatives were expanded by adding optional disposal methods to each alternative. These disposal methods included:

- Deep ocean outfall
- Brackish groundwater recharge
- Injection wells
- Wastewater reclamation

This combination of treatment alternatives and disposal alternatives resulted in a total of twenty-one new capacity treatment alternatives being developed for consideration by the project team. The project team then utilized an evaluation matrix designed to weigh the alternatives based on community-based criteria and technical merit. To ensure that the criteria reflected community values, the CWG developed and weighted each criterion so that the criteria were prioritized. The "Pair wise" comparison method was used to compare criteria to each and rank them accordingly. Through the development and ranking of criteria, the CWG provided the project team with a way to evaluate alternatives that reflected community values and priorities.

Using the weighted criteria, the County's Wastewater Reclamation Division staff ranked the alternatives developed in conjunction with the CWG.

V. Wastewater Capacity Demand Alternatives

The primary objective of this portion of the study was to establish an approach that identifies alternatives to meet the wastewater demands for the Central Maui Region as the region develops. In establishing a methodology for meeting future wastewater capacity demands, two options were considered; new capacity alternatives and demand side alternatives (water conservation and reduction of wastewater system infiltration and inflow). Twenty-one new capacity treatment alternatives, as presented in the previous section entitled, Core Working Group, were considered for meeting Central Maui's future wastewater capacity demands. Figure 4, Evaluation Matrix dated November 29, 2004, identifies these twenty-one new capacity treatment alternatives versus the Evaluation Criteria Matrix.

A Pair wise comparison approach was used to rank the alternatives and identify the recommended alternatives for further consideration. The twenty-one alternatives were ranked by the County team against a 1, 3, 5 rating factor and the criteria weight derived from the pair wise comparison. Based on the results of the ranking, the top 11 alternatives were selected for further evaluation.

Figure 4

Central Maui Wastewater Reclamation Facility Study: Evaluation Matrix 11/29/04

Evaluation Criteria / Alternatives	Cost							Environmental													Reclamation			Other			
	Operations and Maintenance Costs	Treatment Facilities Sunk Cost	Treatment Facilities New Cost	Wastewater Transmission Cost	Cost Impact to Taxpayers	Cost Impact to Sewer Rate Payers	Effluent Transmission Cost	Risk Impact of Operating Failure	Recovery from Catastrophic Failures	Provides for a Reliable Facility Operation	Compatibility Factors (Buffer Zone, Traffic)	Risk / Impact on Community and other facilities / infrastructure	Environmental Permit Requirements	Land Use Permit Requirements	Minimal Noise Impact	Minimal Visual Impact	Minimal Odor Impact / Potential	Environmental / Locational Factors (Corrosion Potential)	Minimal Shoreline Erosion Potential	Tsunami Zone / Flooding Potential	Dual water systems - potable/recycle water	Partnership with Landowners	Ability to expand to meet future capacity needs (land resources, compatibility, new technology)	Modular development - equipment / site expandability	Facility ability to incorporate new technology	Plant expandability/ Long term planning	Influent and effluent flow gravity feeds treatment plant / power generators (energy efficiency)
New Capacity Alternatives	3.3	3.3	3.7	3.5	3.8	3.7	3.4	4.2	4.1	4.1	3.6	3.7	3.1	2.9	3.0	3.3	4.0	3.6	3.8	4.0	2.7	3.1	3.8	3.6	3.9	3.9	3.1
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of injection wells for effluent disposal**.																											
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of brackish groundwater recharge for effluent disposal.**																											
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of ocean outfall for efffluent disposal.**																											
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of water recycling for effluent disposal.**																											
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of injection wells for effluent**																											
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of brackish groundwater recharge for effluent disposal.**																											
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of ocean outfall for effluent disposal.**																											
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Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Develop smaller individual wastewater systems for future capacity. **Use of injection wells for effluent disposal.**																											
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Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of injection wells for effluent disposal.**																											
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Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of water recycling for effluent disposal.**																											
No Build / Do Nothing																											
Demand side Alternatives																											
Initiate water conservation / Produce less waste																											
Replace existing water fixtures																											
Reduce infiltration / inflow																											

The County team requested inclusion of Alternative 14, *Expand existing Wailuku/Kahului WWRF for future capacity; strengthen WWRF for tsunami/erosion concerns, water recycling for effluent disposal*, to assess its viability compared to the top ten alternatives. The No Build/Do Nothing alternative was also considered and ranked last of the 21 alternatives.

The 11 alternatives that were further studied are listed in Table 1 below:

Table 1
Alternative Summary

Rank	Alternative	Effluent Disposal Method
1	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion	Injection wells
2	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Brackish groundwater recharge
3	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Water recycling
4	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Injection wells
5	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones	Brackish groundwater recharge
6	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones.	Water recycling
7	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion.	Brackish groundwater recharge
8	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Ocean outfall
9	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion.	Ocean outfall
10	Construct a new Central Maui WWRF to meet future wastewater treatment needs and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones.	Injection wells
14	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion	Water recycling

In addition to the new capacity alternatives, three water and wastewater demand management alternatives were considered as a means to provide additional wastewater system capacity through managing potable water usage or reducing Infiltration/Inflow (I/I) into the wastewater system. These alternatives, which have been implemented by the county to some extent, include:

- Initiate a water conservation program
- Replace existing high use water fixtures (toilets, showerheads)
- Expand the existing I/I reduction program

These alternatives were ranked within five points of each other making them all equal alternatives to consider. These demand related management alternatives should be considered when implementing a selected new capacity alternative. Considered alone, the cost to implement these alternatives should be comparable or less than the cost of developing new capacity alternatives. The County has implemented a successful ongoing program to mitigate the I/I flow factor impacts on the wastewater system capacity and continue to gain valuable system capacity.

Based on the background, selected alternatives were further developed to provide the County Administration and County Council with conceptual planning level information. It will be used to assist the decision making process to meet Central Maui's future wastewater treatment capacity demands. The two broad options are to either enhance the reliability of the existing Wailuku/Kahului WWRF from tsunami and shoreline erosion impacts, or construct new facilities at a new site.

A comparative summary of the 11 alternatives is presented in the Table 2 entitled, Wastewater Treatment Concept Alternatives Summary. This summary is organized by the three core wastewater treatment concepts that serve as the basis for the selected alternatives.

Table 2 Wastewater Treatment Concept Alternatives Summary

Core Wastewater Treatment Alternative Description	Alternative Rank	Effluent Disposal	Water Recycling Opportunities	Site Options	Community Impacts	Permit Requirements	Cost Impacts	Service Area
Expand Existing WWRF • Expand existing Wailuku/Kahului WWRF to treat future flows • Fortify WWRF to withstand 100 year tsunami • Reinforce shoreline to mitigate shoreline erosion • Construct WWRF effluent filters	1	• R-2 effluent • Injection wells	• Onsite WWRF irrigation • Kanaha Park R-2 irrigation	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• CDUA • SMA • UIC permit	• Capital - $29.9M • O&M - $ • Sunk -	• Central Maui Region
	7	• R-1 effluent • Brackish groundwater recharge • Injection wells	• Onsite WWRF irrigation • Groundwater recharge • Open space irrigation from groundwater withdrawal	• Existing WWRF site • South of Kuihelani highway for groundwater recharge	• Potential for shoreline degradation • Potential for catastrophic system failure caused by tsunami	• CDUA • SMA • UIC permit • Environmental Assessment	• Capital - $81.7M • O&M - $$ • Sunk -	• Central Maui Region
	9	• R-2 effluent • Ocean outfall	• Onsite WWRF irrigation	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• Environmental Impact Statement • CDUA • SMA • UIC permit	• Capital - $101.7M • O&M - $$ • Sunk -	• Central Maui Region
	14	• R-1 effluent • Water recycling • Injection wells	• Onsite WWRF irrigation • Kanaha Park R-1 irrigation • Wailuku/Kahului parks	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• CDUA • SMA • UIC permit • Environmental Assessment	• Capital - $85.9M • O&M - $$ • Sunk -	• Central Maui Region
Construct Regional WWRF • Construct Regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami-proof WWPS at existing WWRF site • Install major wastewater collection system upgrades	2	• R-1 effluent • Brackish groundwater recharge • Requires redundant disposal	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit (Potential) • Rezoning • Community Plan revision	• Capital - $353.7M • O&M - $$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	3	• R-1 effluent • Water Recycling • Requires redundant disposal	• Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $406.3M • O&M - $$$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	4	• R-2 effluent • Injection wells • Requires effluent filters	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact caused by major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $347.4M • O&M - $$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	8	• R-2 effluent • Ocean outfall	• Onsite WWRF irrigation	• Adjacent to Puunene Sugar Mill • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $466.2M • O&M - $$ • Sunk - <$>	• Central Maui Region

Table 2-(cont.) Wastewater Treatment Concept Alternatives Summary

Core Wastewater Treatment Alternative Description	Alternative Rank	Effluent Disposal	Water Recycling Opportunities	Site Options	Community Impacts	Permit Requirements	Cost Impacts	Service Area
Construct 2 New WWRF's • Construct new Central Maui WWRF for future wastewater flows • Relocate Wailuku/Kahului WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Install major wastewater collection system upgrades	5	• R-1 effluent • Brackish groundwater recharge • Redundant effluent disposal required	• Groundwater recharge • Onsite WWRF irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure • Requires large land area	• Environmental Impact Statement • UIC Permit (Potential) • Rezoning • Community Plan Revision	• Capital - $421.3M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei
	6	• R-1 effluent • Water Recycling • Redundant effluent disposal required	• Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport • Keopulani Regional Park	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure • Requires large land area	• Environmental Impact Statement • UIC Permit (Potential) • Rezoning • Community Plan Revision	• Capital - $475.1M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei
	10	• R-2 effluent • Injection wells • Requires effluent filters	• Groundwater recharge • Onsite WWRF irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure	• Environmental Impact Statement • UIC Permit • Rezoning • Community Plan Revision	• Capital - $416.8M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei

Table 3 contains summary of planning level cost estimate ranges for the alternatives, based on the core wastewater treatment concepts, are presented below. The high end cost of each alternative is driven by the deep ocean outfall, brackish groundwater recharge, and water recycling effluent disposal methods.

Table 3
Planning Level Cost Estimates

Core Wastewater Treatment Alternative	Capital Cost Estimate Range (Million Dollars)*
Expand Existing WWRF Expand existing Wailuku/Kahului WWRF for future capacity and fortify facility for tsunami and shoreline erosion	$30 - $105
Construct Regional WWRF Construct new Central Maui WWRF and phase out Wailuku/Kahului WWRF and construct tsunami proof WWPS at existing WWRF site	$350 - $470
Construct 2 New WWRF's Construct new Central Maui WWRF for future wastewater flows, relocate Wailuku/Kahului WWRF, phase out Wailuku/Kahului WWRF and construct tsunami proof WWPS at existing WWRF site	$420 - $475

* 2005 Dollars

The single family customers user fee impact of these alternatives range from a low of $87.82 per billing cycle to a high of $198.26 per billing cycle. The rate impact implementation date varies based on the respective alternative planned start date. A summary of the user fee impacts and start dates are presented in Table 4. The base user fee per billing cycle assuming status quo is $76.82 for 2008, $81.50 for 2010 and $99.12 for 2020. It should be noted that the County would float GO bonds for Alternative 1 and Revenue Bonds for all other alternatives because of County GO bond ceiling limitations.

Table 4
Estimated User Fees

Alternative	Alternative Description	Proposed User Fee/Year
1	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Injection wells for disposal.	$87.82/2009
2	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Brackish groundwater recharge for disposal.	$165.06/2020
3	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Water recycling for disposal.	$179/2020
4	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Injection wells for disposal.	$163.06/2020
5	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Brackish groundwater recharge for disposal.	$181.88/2020
6	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Water recycling for disposal.	$198.26/2020
7	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Brackish groundwater recharge for disposal.	$103.86/2010
8	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Ocean outfall for disposal.	$195.22/2020

Alternative	Alternative Description	Proposed User Fee/Year
9	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Ocean outfall for disposal.	$108.58/2010
10	Construct a new Central Maui WWRF to meet future wastewater treatment needs and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Injection wells for disposal.	$181.88/2020
14	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Water recycling for disposal.	$103.86/2010

Shoreline Evaluation

A critical constraint associated with the alternatives analysis is that many of the County's beaches are eroding, including the shoreline fronting the Wailuku/Kahului WWRF. There are concerns regarding the current erosional trends on the existing and any future plant expansions.

The recommended methods to provide protection to the WWRF site include beach nourishment and construction of revetment. Preliminary alternatives described in this study include;

- beach nourishment with compatible sand material
- beach nourishment with retention structures
- continuing the revetment along the property
- a combination of a revetment extension and beach nourishment.

Evaluation of the alternatives indicates the preferred alternative is the buried revetment. This alternative provides a last line of defense against severe storms and tsunamis and also provides a recreational beach area, which is more amenable to the general public and regulatory agencies. A long-term commitment must be made to ensure future funding for maintenance of the beach fill.

Structural Evaluation

The following buildings/structures were analyzed for overall stability against overturning, sliding, flotation, undermining of foundation due to scour, and structural adequacy of the exterior member(s) to resist tsunami wave force:

- The 30-ft Diameter Sludge Holding Tank
- Operations Building with Elevated Centrifuge Platform
- Effluent Meter Box, Effluent Filters and Chlorine Contact Tanks
- Secondary Clarifiers, Aeration Basins and Aerobic Digester
- Headworks Building

Analysis of these structures was based on the overall stability of the buildings and structural integrity of the individual exterior members facing the ocean, due to scouring, and buoyant, hydrostatic, drag and impact forces, from the 100-year tsunami wave force of height measuring 20.1 feet from the MSL. All other treatment facility structures within the WWRF have been designed and constructed with tsunami concerns having been addressed or have been deemed to be non-essential facilities.

Analysis revealed that, in general, the deficiencies due to lack of embedment of the structure foundation would result in the undermining of the foundation from scouring action at Operations Building housing the elevated Centrifuge Platform, and Headworks Building. Operations Building and Sludge Holding Tank (if not filled) would be deficient in resisting sliding at the base. Individual structural concrete members, at the exterior of the structures consisting of Effluent Meter Box, Filter and Chlorine Contact Tanks, and Headworks Building, as well as metal members of Operations Building and Headworks Building, were found to be deficient.

Recommended corrective measures to address these deficiencies for the evaluated structures included:

- Sludge Holding Tank: Increase the thickness of the tank wall to provide additional weight to resist sliding.
- Operations Building with Elevated Centrifuge Platform: Because metal buildings cannot withstand the forces of tsunami, total reconstruction is the only alternative. If loss of superstructure is operationally tolerable, construction of deep perimeter curb wall to protect the existing building foundation from scour, and concrete guardrail around the platform to protect the equipment from debris, may be considered.
- Various Treatment Tanks and Effluent Metered Structure: Exterior wall of some of the tanks must be thickened to provide additional strength against tsunami force and the existing wall foundation must be extended deeper to resist scour action of the tsunami wave.
- Headworks Building: Extensive modifications must be provided to correct deficiencies against sliding, undermining of the foundation and member strength. Providing additional fill above the existing grade and construction

of drilled piers to resist sliding, and strengthening of concrete columns, walls and elevated slab, as well as strengthening the Headworks Building superstructure is recommended.

VI. Regulatory Assessment

A general overview of State and County plans, policies, land use controls, and environmental laws was performed to determine what will need to be considered in the evaluation of future wastewater treatment alternatives. Since the scope and location of wastewater treatment alternatives are not specific at this time, this report describes governmental requirements in a general land use context. This report is limited to the applicability of governmental permitting requirements and does not include cost of permitting, land acquisition or operations.

The following regulatory requirements would generally assess the alternatives considered by this study. Depending on the complexity of the project, permit processing may range from ten months to two years. Land use entitlements may range from as little as twelve months to more than two years.

- State Land Use District
- General Plan
- Community Plan
- Zoning
- Special Management Area (SMA)
- Shoreline Setback
- Chapter 343, Hawaii Revised Statutes
- Related Studies and Reports

  Depending on the extent of the proposed action and project location, the following studies may be required to complete the applicable permit applications (i.e., SMA, SSV, Environmental Assessments).

  - Archaeological Inventory Survey;
  - Cultural Assessment Report;
  - Coastal Engineering Assessment;
  - Water Quality Assessment;
  - Flora/Fauna Study;
  - Traffic Assessment;
  - Engineering Report (public facilities and services);

  - Drainage Report;
  - Noise and Air Quality Studies; and
  - Community Outreach Report.

- Other Governmental Approvals/Requirements

  Other government approvals/requirements that may have specific permitting requirements would include:

  - Maui County Codes, Chapter 19.62 Flood Hazard Areas
  - Grading Permit
  - Building Permit
  - Electrical Permit
  - Plumbing Permit
  - Environmental Protection Agency (EPA)
  - U.S. Fish and Wildlife Service
  - Department of Health (DOH)
  - Army Corps of Engineers

VII. Financing

The financial impact of the recommended system upgrades on the users and how the resulting financial obligations will be met is an important element of this study. The purpose of this section is to provide a summary of current County financial options and financing mechanisms for its wastewater system, to summarize and evaluate alternative financing programs that the County currently does not utilize, and to provide some pertinent preliminary recommendations. Currently, the primary sources of revenues for the County's wastewater system are sewer user fees and sewer assessments.

- Summary of Utility Funding Trends

  Nationwide, funding for sewer operations, maintenance and capital projects come from the following sources:

  - Sewer Rates & Charges: Sewer rates and charges to users of the system are the largest sources of revenues. Generally, there is a base rate, plus a volume charge.

- Systems Development Charge (SDC): An SDC is a charge to developers and is intended to reflect the increased capital costs incurred by a utility as a result of a development. The County's Sewer Assessments would fall into this category. The City and County of Honolulu's SDC is called System Facilities Charges.

- Local Improvement District (LID) Assessments: LIDs are special assessments levied on property owners for neighborhood public facilities and services, with each property assessed a portion of total project cost. Typical improvements made through the LID process are streets, water lines, sewer lines, sidewalks, and traffic signals.

- Grants: The Community Development Block Grant (CDBG), administered by the U.S. Department of Housing and Urban Development (HUD), provides approximately $2 million annually to County of Maui to distribute to private non-profit entities, government agencies and community-based organizations. Eligible activities include, but are not limited to, real property acquisition, public facilities and improvements, etc.

  The Rural Economic and Community Development Administration (RECD) provides direct loans or loan guarantees to develop water and wastewater system, including storm drainage, in rural areas and to cities and towns with a population of 10,000 or less. RECD also provides grants whose purpose is to reduce water and waste disposal costs to a reasonable level for users of the system.

- Miscellaneous: In some communities where growth is exploding and local government cannot undertake public projects quickly enough, it may enter into an agreement with a developer to pay for infrastructure improvements, with the developers being reimbursed later from Systems Development Charges.

• Summary of Utility Financing Mechanisms

A variety of financing mechanisms are used nationwide to finance utility projects. These include:

- Sewer revenue bonds
- State Revolving Fund (SRF) loans
- Tax-backed bonds (general obligation, limited tax obligations, etc.)
- Loans through various state loan programs

Nationwide, the most prevalent form of sewer system financing is sewer revenue bonds, followed by SRF loans. Other potential financing mechanisms include:

- Tax Increment Financing
- Certificates of Participation
- Municipal Lease Financings
- Privatization
- Variable Rate Debt

• County Financing Mechanism Options

SRF Loans

The County is eligible to participate in the SRF Program. As of June 30, 2004, the County has $31.1 million in outstanding SRF loans, which bear interest at 3.34% to 3.60%.

- General Obligation Bonds: General obligation bonds are secured by a pledge of taxes and the full faith and credit of the County. The County may issue general obligation debt without a vote of the people. The State Constitution limits the amount of general obligation debt a government entity may issue to 15% of its total assessed valuation. The debt limitation for the County is $2.98 billion. As of June 30, 2004, the County's outstanding general obligation debt represents only 8% of its debt limitation.

- Revenue Bonds: The County has the option to issue sewer revenue bonds to fund its sewer improvements. The County debt has traditionally consisted of general obligation bonds or SRF loans. However, the County is considering issuing revenue bonds to fund capital projects of the Department of Water Supply.

- Other: The other types of financing mechanism such as leases, certificates of participation, tax increment financings, privatization, and variable-rate debt all require further legal and financial analysis to determine whether the County can legally enter into those arrangements, the financial costs, the advantages and disadvantages of such arrangements.

• Preliminary Recommendations

The County's success in implementing its wastewater capital plan is dependent upon its ability to generate sufficient cash flow from the operation of its sewer system to pay future debt service.

Because SRF loans represent the lowest-cost of funds, SRF loans should be the first financing mechanism that the County uses. In the absence of SRF loans, general obligation bonds would be the second best option for the County, as they represent the next lowest-cost of funds after SRF loans, and do not require a debt service reserve fund, debt service coverage, or other restrictive covenants. If sewer system capital needs require more than $150 million in debt, the County should engage in conversations with rating agencies to determine whether such a debt load would negatively affect the County's general obligation bond ratings, and whether a revenue bond program would be preferable.

Given that the wastewater capital program could exceed $100 million under certain alternatives, a formal financial plan should be undertaken. This plan should result in a multi-year financial forecast and cash flow projection, which would project revenues, operating expenses, capital needs, debt service and reserves. While there is no requirement that the County calculate debt service coverage so long as there are no revenue bonds issued, it may consider doing so for planning purposes. The plan would identify the funding and financing sources for capital improvements, including a phasing plan. The plan would also review the specific proposed capital projects to identify whether certain projects would be eligible for grant funding. In addition, the plan would review the applicability of non-traditional financing mechanisms to the County's situation.

Such a plan would help the County to spread capital costs over time providing for reasonable increases in user rates and equity among current and future ratepayers, and across user classes.

VIII. Wastewater Alternative Recommendation

- **Remaining WWRF Treatment Capacity**

Based on information presented on Figure 2, Central Maui Region Wastewater Treatment Capacity Demand Forecast, the demand for additional wastewater capacity would be triggered in 2029 when the existing WWRF reaches its design capacity. Corresponding triggering dates to initiate a Facility Plan and the Design, based on Department of Health Regulatory Requirements, are as follows:

Facility Plan:	YR 2008
Design:	YR 2017

Although the need for new wastewater capacity is 25 years into the future, the need for an expanded study of selected treatment alternatives in the near future is two-fold. First, the County needs to have a long-range plan that helps anticipate and prepare for major wastewater improvements. Given the County's financial constraints, this lead-time allows the County to fully explore financial opportunities and position itself to pursue the most viable financial options. Second, this study identified related alternatives to mitigate tsunami and shoreline erosion impacts at the existing Wailuku/Kahului WWRF. Because the tsunami potential is unpredictable and shoreline erosion is ongoing, it is incumbent on the County to begin to pursue related mitigation in the immediate future.

- **Recommendations**

The twenty-one new capacity treatment alternatives that were developed for consideration as a part of this study, represent the various combination of core wastewater treatment facility concepts and direct/indirect effluent disposal options. In addition a No Build/Do Nothing alternative was also considered. A ranking process utilizing the Pair wise comparison approach was used to prioritize the alternatives and identify those recommended for further consideration. Based on the results of this ranking, these top 11 alternatives were selected for further evaluation. These top 11 alternatives represent viable treatment alternatives that would fulfill the objectives of the Maui County General Plan and the Wailuku-Kahului Community Plan, while meeting the County's treatment needs, but would result in varying implementation costs. It should be noted that if the alternative that maintains the existing Wailuku/Kahului WWRF in its current location is selected, an amendment to the Wailuku-Kahului Community Plan would be required to revise item 4 of the Implementing Actions section as it related to Liquid and Solid Waste.

The existing Wailuku/Kahului WWRF has been in operation since the 1970's with the County investing funds in two major expansion and upgrade projects to provide additional treatment capacity, enhance the facility operational reliability, and provide protection from a major tsunami. The upgrade completed in 2004 increased the facility reliability by relocating the aeration blowers, main electrical components and standby generator into a new structure that is above the 100 year tsunami level. In addition, an additional aeration basin was constructed including modifications to the existing aeration basins to provide the facility with a firm rated capacity of 7.9 mgd. The firm rated capacity of 7.9 mgd provides the Central Maui region with adequate wastewater treatment capacity through 2029.

With the primary study objective having been met with the updating of the Central Maui wastewater allocation process and the 2004 facility upgrade, the secondary objective of mitigating impacts from a tsunami and armoring the shoreline remains unresolved and becomes the new primary study objective.

It is recommended that the County move forward with the following plan.

- Implement Alternative 1 with the primary project objective to protect the County's major financial investment in the Wailuku/Kahului WWRF by mitigating the tsunami impact risk and armoring the shoreline fronting the facility. The added community benefit achieved by the armoring of the shoreline is the additional beach park space for the community.

- Continue the Wastewater Reclamation Division proactive program to reduce I/I into the wastewater collection system through collection system rehabilitation and community outreach.

- Continue the Wastewater Reclamation Division partnership with the County Board of Water Supply to implement a comprehensive water conservation program to reduce potable water consumption and wastewater discharge.

The Implementation of Alternative 1 would greatly minimize the risk of losing the processing capacity of the WWRF after a major tsunami. The proposed WWRF tsunami protection improvements will protect the unit processes from a rising tsunami and alleviate inundating the tankage and supportive inplant utilities. With these improvements, the startup of the WWRF could occur soon after a tsunami event.

Alternative 1 has the least financial impact on the community and wastewater rate payers. The study concluded that the project would result in a capital cost of $29.9 million. The two-month billing cycle increase would be approximately $18.72/two month billing cycle increase in sewer user fees, which would be a 27% increase. These projections would begin in FY 2009, based on a base year of FY 2006.

INTRODUCTION

INTRODUCTION

I. Background

The County of Maui, in order to meet its wastewater needs for the Central Maui Region, will need to make decisions that will dictate their future direction. These decisions will determine how the County will meet its wastewater treatment and disposal needs for this region for the next 20 to 30 years. Central to these decisions is the future of the Wailuku/Kahului Wastewater Reclamation Facility (WWRF).

Primary concerns, which the County of Maui faces at its existing Wailuku/Kahului WWRF, are in three primary areas:

1. Remaining capacity at the facility: Available wastewater capacity at the existing Wailuku/Kahului WWRF is approaching its design limits, this based on the County's wastewater allocation record. Based on information presented in this study, however, the demand for additional wastewater capacity would be triggered in 2029 when Wailuku/Kahului reaches its design capacity, this based on updated flow projection data.

2. Shoreline erosion at the facility: The shoreline fronting the Wailuku/Kahului WWRF is constantly being eroded by storm and tidal activity. There are concerns regarding the current erosional trends on the existing facility and any future facility expansions.

3. The potential impact of a tsunami on the facility: In September 1991, Edward K. Noda & Associates prepared a study entitled, "Tsunami Flood Impact Analysis, County of Maui Wastewater Facilities, Wailuku-Kahului, Maui, Hawaii". This study describes the potential tsunami threat as a "non-bore" type, likened to a rapidly rising tide, with water levels rising to a water surface elevation of approximately 21 feet.

These concerns have combined to cause the County of Maui to undertake this study to identify treatment and disposal alternatives for the future. As a part of this project, all combinations of treatment and disposal alternatives will be considered and evaluated.

Previous studies undertaken by the County of Maui dealing with this subject matter includes:

- "Kahului Wastewater Treatment Facility Expansion Study", by Brown and Caldwell, dated August 1989.

- "Wailuku-Kahului Water Reuse Feasibility Study", by Brown and Caldwell, dated June 1991.

- "Evaluation of Expansion of Wailuku-Kahului and Kihei Wastewater Reclamation Facilities", by Austin, Tsutsumi & Associates, Inc., dated September 1991.

- "Wailuku/Kahului Sewer Master Plan", by Brown and Caldwell, dated July 1993.

- "Central Maui Wastewater Reclamation Facility Site", by Brown and Caldwell, dated July 1995.

II. Objectives

The objective of this study is to identify and develop a comprehensive list of conceptual treatment and disposal alternatives that will meet the future wastewater infrastructure requirements for the Central Maui Region. This comprehensive list was then filtered down to approximately 10 alternatives using an evaluation matrix and weighting factors. In developing this wastewater master plan, understanding the community's concerns will plays a major role in concept development. The project scope of work, therefore, was organized to address several primary objectives. These primary objectives included:

- <u>Assure Community Participation</u>: A key component of the study was community participation. The project team wanted to ensure that community principles and values would shape and aid in the selection of the alternatives. For this reason, a Core Working Group was established, with a series of meetings being held to educate the members and develop these principles and values.

- <u>Establish Capacity of Existing Wastewater Infrastructure</u>: The capacity of the existing wastewater infrastructure is an important element of the alternatives development as it serves as the foundation for decision making and scheduling of future infrastructure improvements.

- <u>Determine Effluent Disposal and Biosolids Disposal Options</u>: The disposal or reuse of effluent and biosolids are critical elements in assessing facility location and unit process requirements. The information derived from this task was used in developing and selecting alternatives.

- <u>Define Shoreline Issues</u>: Assess the current and future shoreline erosion trends, and apply this critical information in the development of appropriate alternatives to address the wastewater management needs.

- Define Existing Wastewater Reclamation Facility Structural Issues: Assess the structural stability of those buildings / process areas within the existing facility to withstand the impact of a tsunami. This study dealt only with those components that have not been evaluated in the past.

- Develop Alternatives: Identify and develop conceptual alternatives for meeting the future wastewater infrastructure requirements for the Central Maui regions based on the program values established by the Community and County.

- Initiate a Public Outreach Program: The role of the public outreach program, being a part of this study, initiated the process of raising awareness of the key issues associated with the study's purpose and need. This process laid the foundation for more intensive public information efforts once the Core Working Group completed their work. The general public should have the opportunity to develop a basic understanding of why it is important to create a wastewater reclamation study.

- Develop Financial Planning Alternatives: The team developed financial alternatives. This entailed evaluating and summarizing alternative financing programs coupled with an examination of the County's current financial options and financing mechanisms.

III. Report Organization

The report is organized into the following topics of discussion:

- Core Working Group: A key component of this study was the inclusion of community participation. The objective was to ensure that community principles and values would shape and influence the development of the wastewater capacity demand alternatives.

- Wastewater Capacity Demand Alternatives: The primary objective of this section is to establish an approach that identifies alternatives to meet the wastewater demands for the Central Maui Region as this area develops.

- Regulatory Assessment Report: A component of this study involved a general overview of State and County plans, policies, land use controls and environmental laws, which will need to be considered in the evaluation of future wastewater treatment alternatives.

- Financial Plan: A final key component of this study is the determination of the financial impacts of the recommended system upgrades on the users and how the resulting financial obligations will be met.

- Appendices A, B, C, D, E and F consists of the following supporting topics:

  A. Core Working Group Meeting Minutes

  B. Technical Memorandum Central Maui Wastewater Infrastructure Capacity Assessment

  C. Technical Memorandum Central Maui Wastewater Effluent Disposal Options

  D. Central Maui Wastewater Reclamation Facility Wastewater Capacity Demand Alternatives

  E. Central Maui Wastewater Reclamation Facility Shoreline Evaluation Report

  F. Tsunami Study at the Central Maui Wastewater Reclamation Facility

CORE WORKING GROUP

CORE WORKING GROUP

I. Purpose and Framework

A key component for this study was community participation. The project team wanted to ensure that community principles and values would shape and evaluate the alternatives. It was recognized that community values play a major role in future actions related to the wastewater system. In addition to meeting existing and future community wastewater needs, any future action will have implications related to community financial impacts (taxes and allocation of County resources), environmental impacts and other ramifications.

To ensure meaningful and broad-based participation, the project team convened a project Core Working Group, hereafter referred to as CWG. The CWG is a diverse group of community members who collectively reflect a broad cross section of community values. Its members have interest in wastewater reclamation and related facilities, as well as strong networks with people of like values. The CWG includes people who are involved in:

- the environment,
- development,
- agriculture,
- public utilities,
- finance and business, and
- water reclamation.

Complementing the community CWG members were resource members. These included public officials who have information or may be affected by the wastewater system. Their areas of expertise included County administration, legal matters, the environment, and land ownership and management. The following table lists CWG community and resource members:

Community Members

Dale Bonar	Maui Coastal Land Trust
Grant Chun	Alexander & Baldwin
Lani Correa	Maui Hotel Association
Lucienne deNaie	Sierra Club
Steve Holaday	Hawaiian Commercial & Sugar
Charles Jencks	Maui Contractors Association
Martin Kirk	Hawaii Kiteboarding Association
Clyde Kono	Bank of Hawaii

Warren McCord	Maui Outdoor Circle
Judith Michaels	Maui Tomorrow
Jay Nakamura	Stanford Carr Developments
Mitchell Nishimoto	First Hawaiian Bank
Leiane Paci	Maui Lani Partners
Jan Roberson	Surfrider Foundation
Ed Reinhardt	Maui Electric Company
George Rixey	Kihei Community Association
Glenn Shepherd	Maui Tomorrow (alternate: Sean Lester)
Lynne Woods	Maui Chamber of Commerce
Resources	
Dave Taylor	County of Maui Office of Managing Director
Traci Fujita Villarosa	County of Maui Dept. of Corporation Counsel
Jackie Takakura	County of Maui Dept. of Water Supply
Rob Parsons	County of Maui Environmental Coordinator
Richelle Kawasaki	County of Maui Office of Council Services Legislative Attorney
Ellen Pelissero	County of Maui Office of the Mayor
John Summers	County of Maui Planning Dept.
Zoe Norcross	Sea Grant Coastal Processes Extension Agent, Maui County
Vanessa Medeiros	State Dept. of Hawaiian Home Lands
Jason Koga	State Dept. of Land and Natural Resources

II. Approach in Working with the Core Working Group

The CWG met actively over a 13-month period. The meetings were designed to help CWG members understand the project, explore options, advise the project team on the criteria, and review alternatives. The following summarizes the sequence of meetings:

Meeting 1:
a) Learn about the project, identify tasks and schedule,
b) set framework for guiding principles and scenario planning.

Meeting 2:
a) Develop guiding principles,
b) identify preliminary scenarios,
c) brainstorm alternatives.

Meeting 3: a) Finalize guiding principles,

b) refine scenario alternatives,

c) develop criteria for evaluating alternatives,

d) review study topics.

Meeting 4: a) Rank criteria for evaluation matrix of alternatives,

b) finalize alternatives,

c) review status of project studies.

Meeting 5: a) Review and comment on preliminary ranking of alternatives based on CWG criteria,

b) review status of project studies.

Meeting 6: a) Review of and comment on results of alternatives evaluation, including short list of alternatives,

b) review of findings of project studies.

Meeting 7: Review of draft report.

After each meeting, CWG members were asked to complete an assignment in preparation for the next meeting.

Appendix A contains meeting summaries of each meeting. These summaries were distributed to all CWG community and resource members.

III. Guiding Principles

The CWG developed guiding principles that served as fundamental statements of community values that guide discussions and actions on this project. These principles evolved over two meetings and are as follows:

Future needs

The Central Maui Wastewater Master Plan will provide a long-term vision for accommodating future capacity needs.

Ecosystem

The Central Maui Wastewater Master Plan will promote measures that are the least disruptive to our ecosystem while meeting our wastewater needs.

Reclaimed water

Because reclaimed water is a valuable commodity, the Central Maui Wastewater Master Plan should encourage the highest use of reclaimed water. The Plan should explore ways to optimize system requirements and consider the infrastructure and costs / benefits of reclaimed water.

Technological advances

The Central Maui Wastewater Master Plan should anticipate expansion and future technology advances in the siting and design of new facilities.

Cost analysis

The Central Maui Wastewater Master Plan will clearly delineate and integrate the identification of costs and benefits.

Weighing long- and short-term benefits and impacts.

Regardless of their time frame, benefits and impacts should be given equal consideration in evaluating alternatives. The information in this process should be sufficient and accurate.

Site-selection for new facilities

Site selection for new facilities should be conducted in a thorough and consistent fast-tracked process that includes public input.

New sites

New sites should be environmentally safe where reclaimed water can be efficiently transmitted for irrigation. We should also explore the possibilities of smaller sites in growing communities rather than a big facility to accommodate a large population.

IV. Scenario Building: A Tool to Explore Alternatives

To help the CWG explore a wide range of options within the context of community values, we used scenario planning, a tool often used by corporations and communities to think through possible futures. The process of scenario development engages our imagination while studying actual impacts and analysis. It includes both a narrative product (a story that stretches the imagination), and numbers (information that provides discipline for evaluation and assessment).

Scenario planning is a combination of visioning and strategic planning. A good scenario is one that:

- Provokes debate
- Covers a broad range of alternatives
- Challenges conventional wisdom and helps people think out of the box

- Is memorable
- Is relevant to the audience

Four scenarios were used in this project. The scenarios were developed independent of each other and were intended to reflect ideal scenarios in the year 2020. For each scenario, the CWG and project team identified benchmarks for success and possible strategies to achieve success. Participants then suggested activities and options to carry out the strategies. The four scenarios are presented below:

- **Maximum Water Reclamation**

  Benchmark for Success: By 2020, reclaimed water is commonly used to irrigate the landscaping of public and private property, as well as in agriculture. Further, the County is actively exploring ways to increase the use of reclaimed water.

  Possible strategies to achieve success: Technology, locations, user incentives, partnerships, regulations, other

- **Capacity Management**

  Benchmark for success: In 2020, the Central Maui Wastewater Rec*lamation System plays a major role in the settlement patterns and population growth of Central Maui. It is operationally capable of expanding capacity as needed, as well as restricting capacity to manage growth in certain areas.*

  Possible strategies to achieve success: Technology, level of change, partnerships, other

- **Zero Tolerance for Negative Impacts**

  Benchmark for success: In 2020, the Central Maui Wastewater Reclamation System meets all related Federal, State and County en*vironmental regulations. Further, the community is strongly encouraged to protect and restore the environment in matters related to the wastewater system.*

  Possible strategies to achieve success: Level of change, technology, locations, operations, user initiatives and incentives, others

- **Minimum Taxpayer Burden**

  Benchmark for success: By 2020, the necessary upgrades and impr*ovements to the Central Maui Wastewater Reclamation System were achieved with only a 5% increase in sewer fees over the previous 15 years.*

  Possible strategies to achieve success: Level of change, user incentives, user fees, partnerships, technology-based efficiencies, others

To carry out the various strategies within these scenarios, the CWG and the project team developed several alternatives that ranged from building a new centralized facility to building new satellite facilities to expanding the existing plant, as follows:

1. Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns

2. Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Construct satellite WWRFs for future capacity

3. Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Develop smaller individual wastewater systems for future capacity

4. Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku / Kahului WWRF

5. Build new WWRF for future flows and relocated existing Wailuku / Kahului WWRF away from tsunami and erosion zone

These alternatives were expanded by adding optional disposal methods to each alternative. These disposal methods included:

- Deep ocean outfall
- Groundwater recharge
- Injection wells
- Wastewater reclamation

In addition, a no-action alternative was included to ensure that the full range of alternatives is explored. Further descriptions on these alternatives are provided in (Table 3 of the Capacity Report, Appendix B).

V. Alternatives Evaluation System

The project team developed an evaluation matrix designed to weigh the alternatives based on community-based criteria and technical merit. The matrix essentially listed alternatives in the vertical column and the criteria were presented in the horizontal row.

To ensure that the criteria reflected community values, the CWG developed and weighed each criteria so that criteria were prioritized. "The "pairwise comparison" method was used to compare criteria to each and rank them accordingly. In this comparison, the more valued criteria were given higher points. The following illustrates the basic approach:

If Criteria A is	much more important	than Criteria B, give A the following points	5
	more important		4
	equal		3
	less important		2
	much less important		1

Through the development and ranking of criteria, the CWG provided the project team with a way to evaluate alternatives that reflected community values and priorities. The following lists the CWG evaluation criteria and their related weight.

Evaluation Criteria	**Weighting Factor**
Risk Impact of Operating Failure	4.2
Recovery from Catastrophic Failures	4.1
Provides for a Reliable Facility Operation	4.1
Minimal Odor Impact/Potential	4.0
Tsunami Zone/Flooding Potential	4.0
Facility ability to incorporate new technology	3.9
Plant expandability/Long term planning	3.9
Cost Impact to Taxpayers	3.8
Minimal Shoreline Erosion Potential	3.8
Ability to expand to meet future capacity needs (land resources, compatibility, new technology)	3.8
Treatment Facilities New Cost	3.7
Cost Impact to Sewer Rate Payers	3.7
Risk/Impact on Community and other facilities/infrastructure	3.7
Plant Compliances – Reclamation Potential, Storm water regulation, WW Solids Handling, Composting	3.7

Evaluation Criteria	**Weighting Factor**
Compatibility Factors (Buffer Zone, Traffic)	3.6
Environmental/Location Factors (Corrosion Potential)	3.6
Modular development – equipment/site expandability	3.6
Wastewater Transmission Cost	3.5
Effluent Transmission Cost	3.4
Operations and Maintenance Costs	3.3
Treatment Facilities Sunk Cost	3.3
Minimal Visual Impact	3.3
Environmental Permit Requirements	3.1
Partnership with Landowners	3.1
Influent and effluent flow gravity feeds treatment plant/power generators (energy efficiency)	3.1
Minimal Noise Impact	3.0
Land Use Permit Requirements	2.9
Dual water systems – potable/recycle water	2.7

In summary, the weighted criteria can be summarized in four categories, as follows. The proportional weight of the categories, based on 100 percent, is as follows:

Environment:...... 47%	(13 Criteria)
Cost:................... 25%	(7 Criteria)
Recycling: 10%	(3 Criteria)
Other: 18%	(5 Criteria)
Total: 100%	

Using the weighted criteria, the County Wastewater Reclamation Division ranked the alternatives that were developed in conjunction with the CWG. The final ranking of alternatives based on these criteria is presented in Table 4 of the Capacity Report, Appendix B.

WASTEWATER CAPACITY DEMAND ALTERNATIVES

WASTEWATER CAPACITY DEMAND ALTERNATIVES

I. Background

The primary objective of this study is to establish an approach that identifies alternatives to meet the wastewater demands for the Central Maui Region as the region develops. The County's wastewater allocation records indicate that the existing Wailuku/Kahului WWRF will reach its design capacity within 10 years based on the current rate of economic growth.

An exercise was undertaken to confirm the County of Maui's wastewater allocation records based on recorded Wailuku/Kahului WWRF flows. The results indicate that a more realistic Central Maui Region wastewater treatment capacity demand forecast is as shown in Figure 2-1. Using the forecast presented in Figure 2-1, the demand for additional wastewater capacity would be triggered in 2029 when Wailuku/Kahului reaches its design capacity.

Although new wastewater capacity demand is 25 years into the future there is value in presenting the selected treatment alternatives. An important secondary objective of this study is to identify related alternatives to mitigate tsunami and shoreline erosion impacts at the existing Wailuku/Kahului WWRF.

In establishing a methodology for meeting future wastewater capacity demands two options were considered; new capacity and demand-side management (water conservation and reduction of wastewater system infiltration and inflow). Twenty-one new capacity treatment alternatives, detailed in Appendix B, were considered for meeting Central Maui's future wastewater capacity demands.

The County team, Community Core Working Group and consultant team identified alternatives that met evaluation criteria and community values established in separate exercises. Five core wastewater treatment facility concepts were selected as the basis for alternatives with multiple effluent disposal options. The five core wastewater treatment facility concepts selected were:

- Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion.
- Maintain the existing Wailuku/Kahului WWRF at its current capacity; fortify facility to protect against tsunamis and shoreline erosion and construct satellite WWRF(s) to meet future wastewater capacity demands.
- Maintain the existing Wailuku/Kahului WWRF at its current capacity, fortify facility to protect against tsunamis and shoreline erosion and require new development to install individual wastewater systems.

- Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.

- Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion impacts.

Direct and indirect effluent disposal options were selected for consideration and included:

- Injection wells
- Deep ocean outfalls
- Brackish groundwater recharge
- Water recycling

The indirect disposal options of brackish groundwater recharge and water recycling require redundant disposal systems as mandated by DOH regulations.

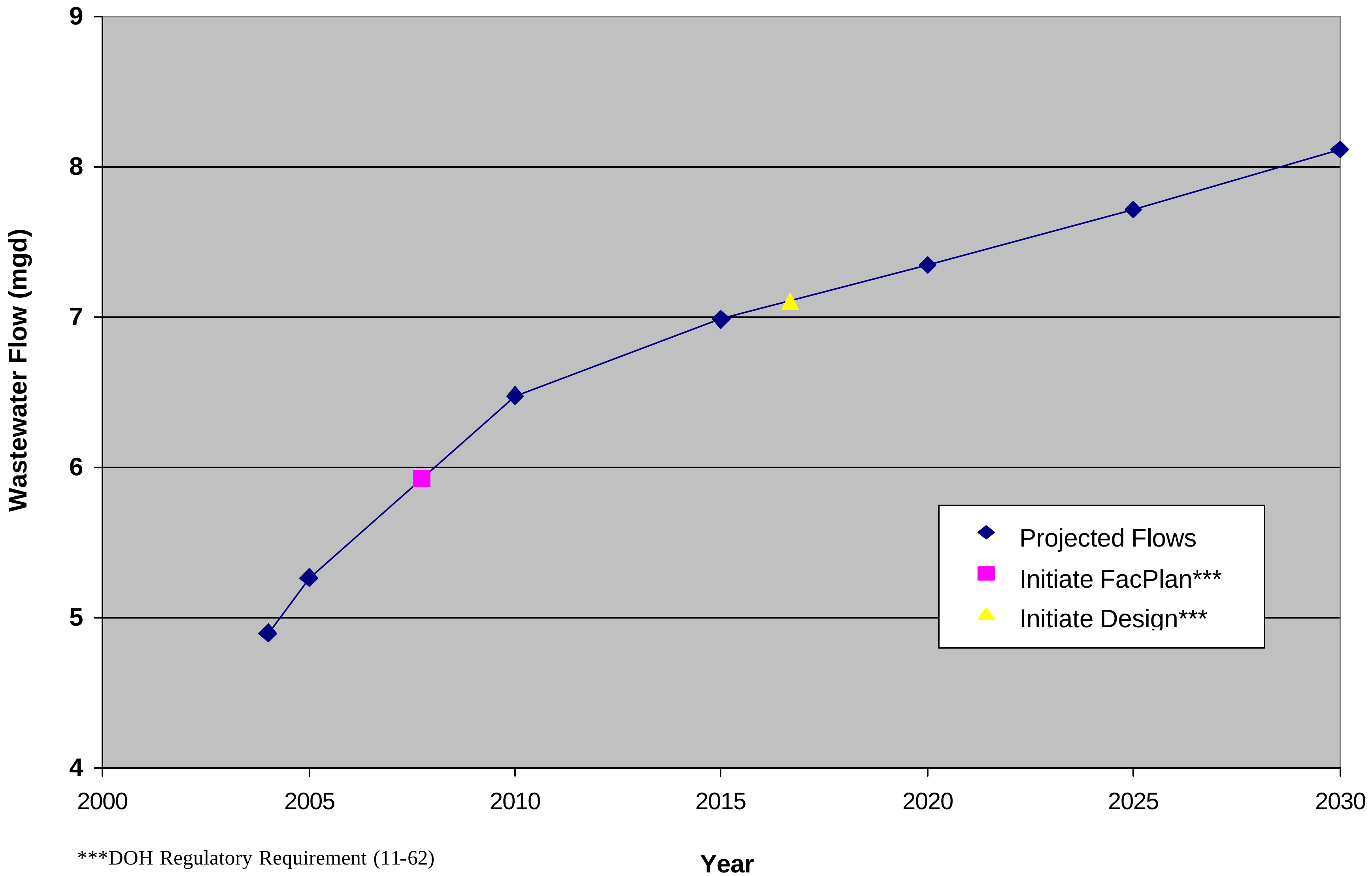
A ranking process utilizing the pair-wise comparison approach was used to rank the alternatives and identify the recommended alternatives for further consideration. The 21 alternatives were ranked by the County team against a 1, 3, 5 rating factor and the criteria weight derived from the pair-wise comparison. Based on the results of the ranking the top 10 alternatives were selected for further evaluation. Appendix B, Capacity Report outlines the process used to identify the 10 ranked alternatives. The selected alternatives are listed in Table 2-1.

The County team requested inclusion of Alternative 14, *Expand existing Wailuku/Kahului WWRF for future capacity; strengthen WWRF for tsunami/erosion concerns, water recycling for effluent disposal*, to assess its viability compared to the top ten alternatives. The No Build/Do Nothing alternative was also considered and ranked last of the 21 alternatives.

In addition to the new capacity alternatives, three water and wastewater demand management alternatives were considered as a means to provide additional wastewater system capacity through managing potable water usage or reducing Infiltration/Inflow (I/I) into the wastewater system. These alternatives, which have been implemented by the county to some extent, include:

- Initiate a water conservation program
- Replace existing high-use water fixtures (toilets, showerheads)
- Expand the existing an I/I reduction program

Figure 2-1. Central Maui Region
Wastewater Treatment Capacity Demand Forecast



***DOH Regulatory Requirement (11-62)

Table 2-1. Wastewater Treatment Concept Alternatives

Rank	Alternative	Effluent Disposal Method
1	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion	Injection wells
2	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Brackish groundwater recharge
3	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Water recycling
4	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Injection wells
5	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones	Brackish groundwater recharge
6	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones.	Water recycling
7	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion.	Brackish groundwater recharge
8	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF.	Ocean outfall
9	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion.	Ocean outfall
10	Construct a new Central Maui WWRF to meet future wastewater treatment needs and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones.	Injection wells
14	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion	Water recycling

These alternatives were ranked within 5 points of each other making them all equal alternatives to consider. These demand management alternatives should be considered when implementing a selected new capacity alternative. Considered alone, the cost to implement these alternatives should be comparable or less than the cost of developing new capacity alternatives. The County has implemented a successful ongoing program to mitigate the I/I flow factor impacts on the wastewater system capacity and continue to gain valuable system capacity.

Based on the background, selected alternatives were further developed to provide the County Administration and County Council with conceptual planning level information. It will be used to assist the decision making process to meet Central Maui's future wastewater treatment capacity demands. The two broad options are to either enhance the reliability of the existing Wailuku/Kahului WWRF from tsunami and shoreline erosion impacts, or construct new facilities at a new site.

II. Alternatives Development

The conceptual alternatives were developed with no specific new facility location or size being established at this point in the process. The information developed will allow the County decision makers to establish a direction to maintain the existing Wailuku/Kahului WWRF location, relocate the Wailuku/Kahului WWRF, pursue a new facility at a new site or a combination thereof.

Each alternative was developed using the following decision making considerations:

Alternative Description:

Three core wastewater treatment concepts developed in an earlier exercise, serve as the basis for the top 11 alternatives presented later in this chapter. These concepts are:

- Expand the existing Wailuku/Kahului WWRF
- Construct regional WWRF. Phase out existing Wailuku/Kahului WWRF.
- Construct two new WWRF's. Phase out existing Wailuku/Kahului WWRF.

Level of treatment will be driven by the selected effluent disposal option. Secondary treatment will be the minimum treatment level required for ocean outfall disposal. Tertiary treatment will be required for brackish groundwater recharge, injection well disposal and water recycling.

Water Recycling Opportunities:

Water recycling opportunities will be determined by the WWRF(s) location and level of treatment provided. The Wailuku-Kahului Water Reuse Feasibility Study dated June 1991 indicates that there is significant potential for water reclamation and reuse on Maui. Specific reclamation projects near the Wailuku-Kahului WWRF were developed and evaluated for the study.

The findings from this study will be used as the basis for evaluating water recycling opportunities. An emerging concept not discussed in the 1991 study is that of the use of a “scalping plant” which consists of a packaged treatment system capable of delivering DOH approved R-1 level water. These can be located near a WWPS and a site available for R-1 water. A schematic of a representative system is shown in Figure 2-2.

Site Options:

Conceptual WWRF site options considered for this study are located as shown in Figure 2-3. Figure 2–3 locates the potential new alternative WWRF sites areas presented in each alternative and highlights the tsunami/flood zone for the Wailuku/Kahului region. The potential sites included:

- Ke’opu’olani County Park
- South of Kuihelani Highway
- Pu’unene Sugar Mill
- South of Kahului Airport
- Old Pu’unene Airport

These sites were selected based on proximity to developed lands, adjacent land uses, potential for water recycling and or brackish groundwater recharge.

Service Area:

The wastewater service area for the alternatives will be defined by the location of the proposed WWRF’s. Depending on location of the WWRF, the communities in the Wailuku/Kahului and or South Maui Community Plan regions could be served by the listed site options. The Old Pu’unene Airport site is the only site that would be viable to provide new wastewater capacity for South Maui including Maalaea area.

Community Impacts:

The anticipated positive and negative impacts (community and financial) were identified using the community guiding principles established by the Core Working Group during the alternative evaluation process. Table 2-2 lists these community guiding principles as established by the Core Working Group.

Permit Requirements:

Each alternative will require both regulatory and land use permits. An assessment of the various permit requirements was done to identify the potential permits for the respective alternatives. The most challenging permitting processes would be those permits required to construct an ocean outfall and to armor the shoreline, owing to the potential negative impact on the environment.

Cost Impacts:

The most probable planning level costs for capital and O&M to implement, operate and maintain the respective alternatives were determined. A Class 4 estimate, defined as the "study or feasibility" level listed in the ***Skills and Knowledge of Cost Engineering***, AACE 3rd Edition. This estimate level is appropriate for the preliminary design stages of the project. The expected range of accuracy of a Class 4 estimate typically is (+) 50 percent to (-) 20 percent. With the recent dramatic rise in construction costs due to the high demand, housing market boom, limited contractors, and low unemployment, a (+) 50 percent increase over the construction cost estimate should be used for budgetary purposes.

The impact of sunk cost considers the continued beneficial use of the existing Wailuku/Kahului WWRF. Abandonment of the existing Wailuku/Kahului WWRF would negate the benefits of the sunk cost associated with the Wailuku/Kahului WWRF.

The capital costs considered for each alternative include the following as applicable:

- Shoreline armoring
- Tsunami fortification of existing Wailuku/Kahului WWRF
- New WWRF
- New wastewater collection system
- New wastewater pump station
- New recycled water distribution network
- Effluent disposal system
- Permitting requirements

Figure 2-2 – Satellite/Scalping WWRF

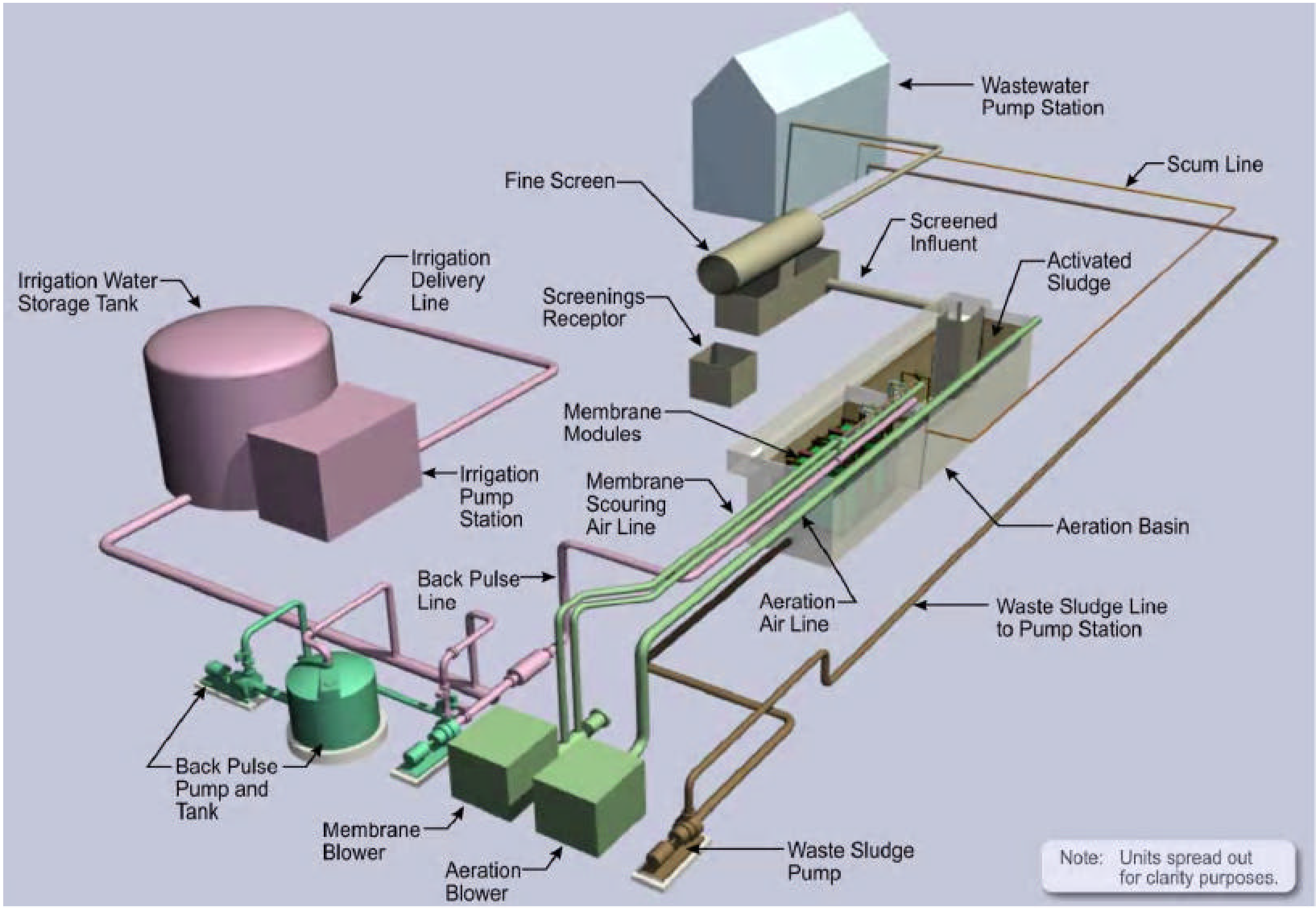


Figure 2-3. Alternative WWRF Site Areas

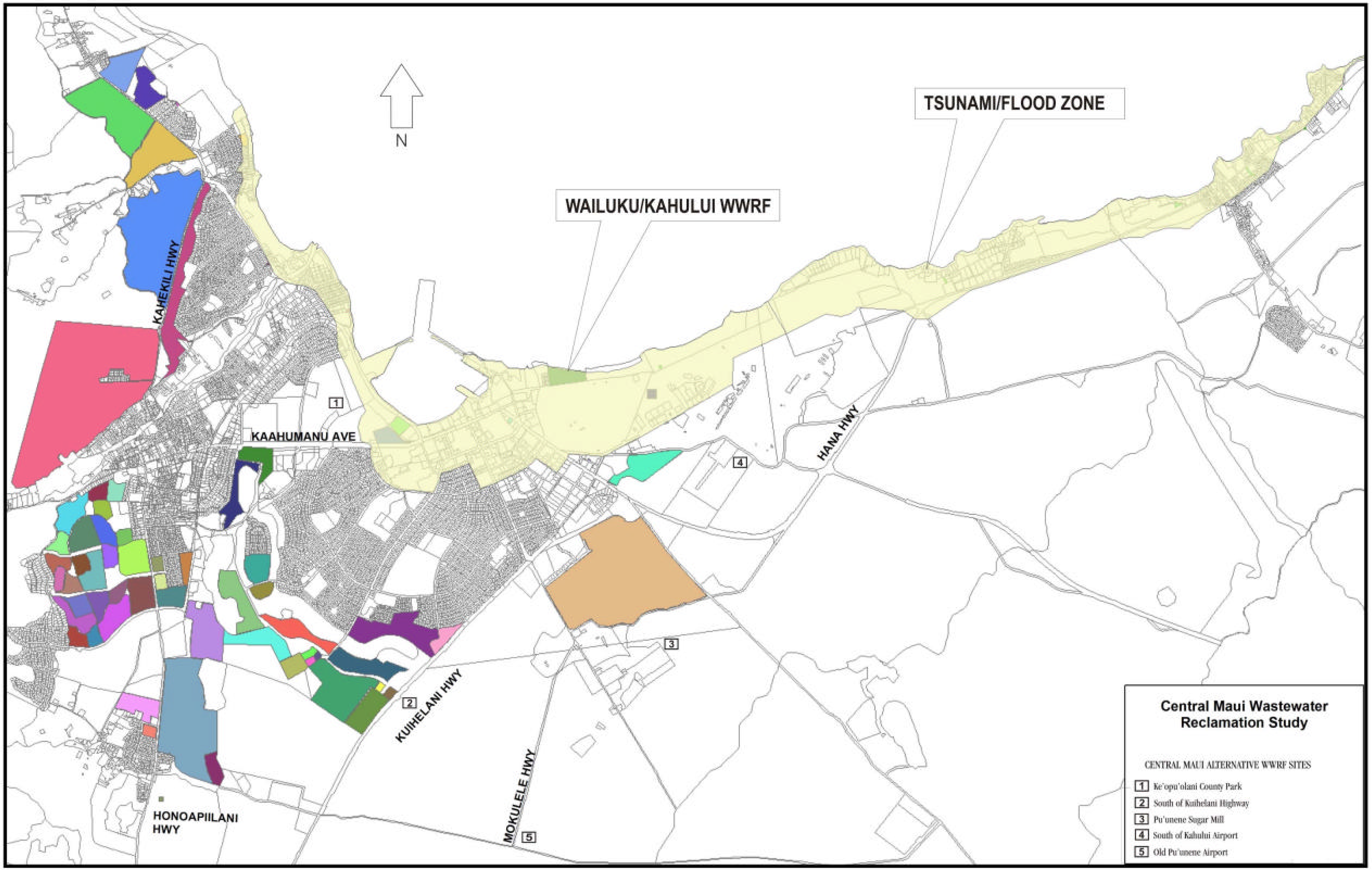


Table 2-2. Community Guiding Principles

Guiding Principles	***Definitions***
Future needs	The Central Maui Wastewater Master Plan will provide a long-term vision for accommodating future capacity needs.
Ecosystem	The Central Maui Wastewater Master Plan will promote measures that are the least disruptive to our ecosystem while meeting our wastewater needs.
Reclaimed water	Because reclaimed water is a valuable commodity, the Central Maui Wastewater Master Plan should encourage the highest use of reclaimed water. The Plan should explore ways to optimize system requirements and consider the infrastructure and costs/benefits of reclaimed water.
Technological advances	The Central Maui Wastewater Master Plan should anticipate expansion and future technology advances in the siting and design of new facilities.
Cost analysis	The Central Maui Wastewater Master Plan will clearly delineate and integrate the identification of costs and benefits.
Weighing long- and short-term benefits and impacts	Regardless of their time frame, benefits and impacts should be given equal consideration in evaluating alternatives. The information in this process should be sufficient and accurate.
Site-selection for new facilities	Site selection for new facilities should be conducted in a thorough and consistent fast-tracked process that includes public input.
New sites	New sites should be environmentally safe where reclaimed water can be efficiently transmitted for irrigation. We should also explore the possibilities of smaller sites in growing communities rather than a big facility to accommodate a large population.

A<$> sunk cost notation in Table 2-15 means that the alternative does not take advantage of the existing WWRF infrastructure.

Tables 2-3 through 2-13 present the details of the 11 alternatives. A comparative summary of the 11 alternatives are presented in Table 2-14. The summary is organized by the three core wastewater treatment concepts that serve as the basis for the selected alternatives.

Table 2–15 presents a summary of the most probable planning level cost estimate for the alternatives capital improvements categorized by the core wastewater treatment concepts. The high end cost of each alternative is driven by the deep ocean outfall, brackish groundwater recharge, and water recycling effluent disposal methods.

Table 2-3

Central Maui WWRF Study
Alternative 1 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	N/A	0
WWRF	• Expansion Capacity – N/A • On site WWRF irrigation • Kanaha Park R-2 irrigation	0
WWRF Tsunami Protection	• Fortify to withstand 100 yr	$16.1 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• Injection wells • Effluent quality - R-2	$4.3 M

General Assumptions:

1. Existing Wailuku/Kahului WWRF has adequate capacity through 2029.
2. Effluent disposal injection wells will require rehabilitation or replacement to provide redundant capacity.
3. Replace solids handling/dewatering facility to mitigate 100 year tsunami impact.
4. Replace operations building to mitigate 100 year tsunami impact.
5. Shoreline armoring will require beach replenishment at planned frequency.
6. Recommended upgrades should be planned for completion within 2 years.

Table 2-4

Central Maui WWRF Study
Alternative 2 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 16 mgd • Forcemain (FM) - 20 inch Ductile Iron (DI) • 2.5 mile long FM • Tsunamiproof	\$35.9 M \$13.7 M
WWRF	• Construct new CM WWRF • Capacity - 8 mgd • MBR process • Onsite WWRF irrigation • Open space irrigation	\$283.2 M
Shoreline Protection	• Armor shoreline	\$9.6 M
Effluent Disposal	• Groundwater recharge • 70,000 gallons/acre/day • 100% redundancy required • Effluent quality – R-1 • Gravity flow to recharge site	\$11.3 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. Shoreline armoring will require beach replenishment at planned frequency.
3. Recommended shoreline armoring should be planned for completion within 5 years.
4. Land requirement for groundwater recharge is 113 acres based on a flow of 7.9 mgd.
5. Effluent disposal redundancy based on injection wells.
6. Land cost not included in cost estimate.

Table 2-5

Central Maui WWRF Study
Alternative 3 – Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 16 mgd • Force Main – 20 inch DI • 2.5 miles long • Tsunamiproof	$35.9 M $13.7 M
WWRF	• Construct new CM WWRF • Capacity – 8 mgd • MBR process • Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	$283.2 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• WW collection system upgrade • Effluent quality – R-1 • Water recycling • 100% redundancy required	$53.8 M $10.1 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.

2. Shoreline armoring will require beach replenishment at planned frequency.

3. Recommended shoreline armoring should be planned for completion within 5 years.

4. Effluent disposal redundancy based on injection wells.

Table 2-6

Central Maui WWRF Study
Alternative 4 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 16 mgd • Force Main – 20 inch DI • 2.5 miles long • Tsunamiproof	\$35.9 M \$13.7 M
WWRF	• Construct new CM WWRF • Capacity – 8 mgd • MBR process • Onsite WWRF irrigation • Open space irrigation	\$283.2 M
Shoreline Protection	• Armor shoreline	\$9.6 M
Effluent Disposal	• Effluent quality – R-2 • Injection wells	\$10.1 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. Shoreline armoring will require beach replenishment at planned frequency.
3. Recommended shoreline armoring should be planned for completion within 5 years.

Table 2-7

Central Maui WWRF Study
Alternative 5 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 14 mgd • Force Main – 20 inch DI • 2.5 miles long • Tsunamiproof	\$31.3 M \$13.7 M
WWRF	• Construct new CM WWRF (Capacity – 1 mgd) • Relocate existing WWRF (Capacity – 7 mgd) • Effluent quality – R-1 • MBR process • Onsite WWRF irrigation	\$354.1 M
Shoreline Protection	• Armor shoreline	\$9.6 M
Effluent Disposal	• WW collection system upgrade • Groundwater recharge • 70,000 gallons/acre/day • 100% redundancy required	\$12.6 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. New CM WWRF based on 1 mgd scalping WWRF.
3. Shoreline armoring will require beach replenishment at planned frequency.
4. Recommended shoreline armoring should be planned for completion within 5 years.
5. Land requirement for groundwater recharge is 99 acres based on a flow of 7 mgd.
6. Effluent disposal redundancy based on injection wells.

Table 2-8

Central Maui WWRF Study
Alternative 6 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 14 mgd • Force Main – 20 inch DI 2.5 miles long • Tsunamiproof	$31.3 M $13.7 M
WWRF	• Construct new CM WWRF (Capacity – 1 mgd) • Relocate existing WWRF (Capacity – 7 mgd) • Effluent quality – R-1 • MBR process • Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	$354.1 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• WW collection system upgrade • Water recycling • 100% redundancy required	$53.8 M $12.6 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. New CM WWRF based on 1mgd scalping WWRF.
3. Shoreline armoring will require beach replenishment at planned frequency.
4. Recommended shoreline armoring should be planned for completion within 5 years.
5. Effluent disposal redundancy based on injection wells.

Table 2-9

Central Maui WWRF Study
Alternative 7 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	N/A	
WWRF	• Expansion Capacity – N/A • Effluent quality - R-1 • Onsite WWRF irrigation • Open space irrigation	$5.1 M
WWRF Tsunami Protection	• Fortify to withstand 100 yrs	$16.1 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Pump Station	• Capacity – 16 mgd • Force Main – 20 inch DI • 2.5 miles long	$35.9 M $13.7 M
Effluent Disposal	• Groundwater recharge • 70,000 gallons/acre/day • 100% redundancy required	$1.3 M

General Assumptions:

1. Existing Wailuku/Kahului WWRF has adequate capacity through 2029.
2. R-1 quality effluent requires replacement of disinfection system – UV disinfection.
3. 100% effluent disposal redundancy met by existing injection wells. Rehabilitation of existing wells required to provide required redundant capacity.
4. Replace solids handling/dewatering facility to mitigate 100 year tsunami impact.
5. Replace operations building to mitigate 100 year tsunami impact.
6. Shoreline armoring will require beach replenishment at planned frequency.
7. Recommended in plant upgrades should be planned for completion within 2 years.
8. Land requirement for groundwater recharge is 113 acres based on a flow of 8 mgd.
9. Land cost not included in cost estimate.

Table 2-10

Central Maui WWRF Study
Alternative 8 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 16 mgd • Force Main – 20 inch DI • 2.5 miles long • Tsunamiproof	$35.9 M $13.7 M
WWRF	• Construct new CM WWRF • Capacity - 8 mgd • Conventional Activated Sludge process • Onsite WWRF irrigation	$324.5 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• Effluent quality R-2 • Ocean outfall (10,560 Feet) • Effluent WWPS – 16 mgd • 2.5 mile 20” DI forcemain	$40.1 M $28.7 M $13.7 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. Shoreline armoring will require beach replenishment at planned frequency.
3. Recommended shoreline armoring should be planned for completion within 5 years.

Table 2-11

Central Maui WWRF Study
Alternative 9 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	N/A	
WWRF	• Expansion Capacity – N/A • Onsite WWRF irrigation	
WWRF Tsunami Protection	• Fortify to withstand 100 yrs	$16.1 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Pump Station	• Capacity – 16 mgd	$35.9 M
Effluent Disposal	• Effluent quality – R-2 • Ocean outfall (10,560 Feet)	$40.1 M

General Assumptions:

1. Existing Wailuku/Kahului WWRF has adequate capacity through 2029.
2. Replace solids handling/dewatering facility to mitigate 100 year tsunami impact.
3. Replace operations building to mitigate 100 year tsunami impact
4. Shoreline armoring will require beach replenishment at planned frequency.
5. Recommended in plant upgrades should be planned for completion within 2 years.

Table 2-12

Central Maui WWRF Study
Alternative 10 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	• Capacity – 14 mgd • Force Main – 20 inch DI 2.5 miles long • Tsunamiproof	$31.3 M $13.7 M
WWRF	• Construct new CM WWRF (Capacity – 1 mgd) • Relocate existing WWRF (Capacity – 7 mgd) • Effluent quality – R-1 • MBR process • Onsite WWRF irrigation	$349.6 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• Injection wells • WW collection system upgrade • Effluent quality – R-2	$12.6 M

General Assumptions:

1. Phase out existing Wailuku/Kahului WWRF from service.
2. New CM WWRF based on 1 mgd scalping WWRF.
3. Shoreline armoring will require beach replenishment at planned frequency.
4. Recommended shoreline armoring should be planned for completion within 5 years.

Table 2-13

Central Maui WWRF Study
Alternative 14 - Planning Level Cost Estimate

Component	Assumptions	Cost Estimate
Influent WWPS	N/A	
WWRF	• Expansion Capacity – N/A • Effluent quality - R-1 • Onsite WWRF irrigation • Open space irrigation	$5.1 M
WWRF Tsunami Protection	• Fortify to withstand 100 yrs	$16.1 M
Shoreline Protection	• Armor shoreline	$9.6 M
Effluent Disposal	• Water Recycling • 100% redundancy required	$53.8 M $1.3 M

General Assumptions:

1. Existing Wailuku/Kahului WWRF has adequate capacity through 2029
2. R-1 quality effluent requires replacement of disinfection system – UV disinfection
3. 100% effluent disposal redundancy met by existing injection wells. Rehabilitation of existing wells required to provide redundant disposal capacity.
4. Replace solids handling/dewatering facility to mitigate 100 year tsunami impact
5. Replace operations building to mitigate 100 year tsunami impact
6. Shoreline armoring will require beach replenishment at planned frequency
7. Recommended in plant upgrades should be planned for completion within 5 years.

Table 2-14 Wastewater Treatment Concept Alternatives Summary

Core Wastewater Treatment Alternative Description	Alternative Rank	Effluent Disposal	Water Recycling Opportunities	Site Options	Community Impacts	Permit Requirements	Cost Impacts	Service Area
Expand Existing WWRF • Expand existing Wailuku/Kahului WWRF to treat future flows • Fortify WWRF to withstand 100 year tsunami • Reinforce shoreline to mitigate shoreline erosion • Construct WWRF effluent filters	1	• R-2 effluent • Injection wells	• Onsite WWRF irrigation • Kanaha Park R-2 irrigation	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• CDUA • SMA • UIC permit	• Capital - $25.7M • O&M - $ • Sunk -	• Central Maui Region
	7	• R-1 effluent • Brackish groundwater recharge • Injection wells	• Onsite WWRF irrigation • Groundwater recharge • Open space irrigation from groundwater withdrawal	• Existing WWRF site • South of Kuihelani highway for groundwater recharge	• Potential for shoreline degradation • Potential for catastrophic system failure caused by tsunami	• CDUA • SMA • UIC permit • Environmental Assessment	• Capital - $80.4M • O&M - $$ • Sunk -	• Central Maui Region
	9	• R-2 effluent • Ocean outfall	• Onsite WWRF irrigation	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• Environmental Impact Statement • CDUA • SMA • UIC permit	• Capital - $101.7M • O&M - $$ • Sunk -	• Central Maui Region
	14	• R-1 effluent • Water recycling • Injection wells	• Onsite WWRF irrigation • Kanaha Park R-1 irrigation • Wailuku/Kahului parks	• Existing WWRF site	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami	• CDUA • SMA • UIC permit • Environmental Assessment	• Capital - $81.6 • O&M - $$ • Sunk -	• Central Maui Region
Construct Regional WWRF • Construct Regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami -proof WWPS at existing WWRF site • Install major wastewater collection system upgrades	2	• R-1 effluent • Brackish groundwater recharge • Requires redundant disposal	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit (Potential) • Rezoning • Community Plan revision	• Capital - $352.5M • O&M - $$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	3	• R-1 effluent • Water Recycling • Requires redundant disposal	• Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $406.3M • O&M - $$$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	4	• R-2 effluent • Injection wells • Requires effluent filters	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact caused by major capital expenditure • Increased potential for odor discharges	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $347.4M • O&M - $$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei
	8	• R-2 effluent • Ocean outfall	• Onsite WWRF irrigation	• Adjacent to Puunene Sugar Mill • South of Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision	• Capital - $466.2M • O&M - $$ • Sunk - <$>	• Central Maui Region

Table 2-14 Wastewater Treatment Concept Alternatives Summary

Core Wastewater Treatment Alternative Description	Alternative Rank	Effluent Disposal	Water Recycling Opportunities	Site Options	Community Impacts	Permit Requirements	Cost Impacts	Service Area
Construct 2 New WWRF's • Construct new Central Maui WWRF for future wastewater flows • Relocate Wailuku/Kahului WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Install major wastewater collection system upgrades	5	• R-1 effluent • Brackish groundwater recharge • Redundant effluent disposal required	• Groundwater recharge • Onsite WWRF irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure • Requires large land area	• Environmental Impact Statement • UIC Permit (Potential) • Rezoning • Community Plan Revision	• Capital - $421.3M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei
	6	• R-1 effluent • Water Recycling • Redundant effluent disposal required	• Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport • Keopulani Regional Park	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure • Requires large land area	• Environmental Impact Statement • UIC Permit (Potential) • Rezoning • Community Plan Revision	• Capital - $475.1M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei
	10	• R-2 effluent • Injection wells • Requires effluent filters	• Groundwater recharge • Onsite WWRF irrigation	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure	• Environmental Impact Statement • UIC Permit • Rezoning • Community Plan Revision	• Capital - $416.8M • O&M - $$$ • Sunk - <$>	• Central Maui • Maalaea • North Kihei

Table 2-15 Core Wastewater Treatment Alternatives
Capital Cost Estimate – (2005) Dollars

Core Wastewater Treatment Alternative	Capital Cost Estimate Range (Million Dollars)*
Expand Existing WWRF Expand existing Wailuku/Kahului WWRF for future capacity and fortify facility for tsunami and shoreline erosion	$30 - $105
Construct Regional WWRF Construct new Central Maui WWRF and phase out Wailuku/Kahului WWRF and construct tsunami proof WWPS at existing WWRF site	$350 - $470
Construct 2 New WWRF's Construct new Central Maui WWRF for future wastewater flows, relocate Wailuku/Kahului WWRF, phase out Wailuku/Kahului WWRF and construct tsunami proof WWPS at existing WWRF site	$420 - $475

* 2005 Dollars

III. Recommendations

The existing Wailuku/Kahului WWRF has been in operation since the 1970's with the County investing funds in two major expansion and upgrade projects to provide additional treatment capacity and enhance the facility operational reliability and protection from a major tsunami. The upgrade completed in 2004 increased the facility reliability by relocating the aeration blowers, main electrical components and standby generator into a new structure that is above the 100 year tsunami level. In addition, an additional aeration basin was constructed including modifications to the existing aeration basins to provide the facility with a firm rated capacity of 7.9 mgd. The firm rated capacity of 7.9 mgd provides the Central Maui region with adequate wastewater treatment capacity through 2029 as reflected in Figure 2-1.

Although the primary study objective is met with the updating of the Central Maui wastewater allocation process and the 2004 facility upgrade, the secondary objective of mitigating impacts from a tsunami and armoring the shoreline is not resolved. It is recommended that the County move forward with the following plan.

- Implement Alternative 1 with the primary project objective to protect the County's major financial investment in the Wailuku/Kahului WWRF by mitigating the tsunami impact risk and armoring the shoreline fronting the facility. The added community benefit achieved by the armoring of the shoreline is the additional beach park space for the community.
- Wastewater Reclamation Division continues with its proactive program to reduce I/I into the wastewater collection system through collection system rehabilitation and community outreach.
- Wastewater Reclamation Division works in partnership with the County Board of Water Supply to implement a comprehensive water conservation program to reduce potable water consumption and wastewater discharge.
- Reconsider water reuse opportunities for Central Maui with the recent technology advances that make constructing a scalping WWRF cost effective. The Maui Community College, Ke'opu'olani Regional Park, War Memorial Complex and Baldwin High school provides that opportunity to recover this valuable water resource and provide additional wastewater capacity at the Wailuku/Kahului WWRF.

The Implementation of Alternative 1 would greatly minimize the risk of losing the processing capacity of the WWRF after a major tsunami. The proposed WWRF tsunami protection improvements will protect the unit processes from a rising tsunami and alleviate inundating the tankage and supportive inplant utilities. The startup of the WWRF could occur soon after a tsunami event.

Alternative 1 has the least financial impact on the community and wastewater rate payers at a capital cost of $25.7 million or $5.30/Billing cycle increase in sewer user fees beginning in FY 2008.

Future Central Maui wastewater capacity demands beyond the increased capacity provided by the recommended scalping WWRF can be met by constructing additional satellite or scalping WWRF(s) at strategic points in the Central Maui region to meet the community desire to recycle this valuable water resource and mitigate expensive and community impacting collection system improvement.

REGULATORY ASSESSMENT REPORT

REGULATORY ASSESSMENT REPORT

I. INTRODUCTION

A. Background and Purpose

A component of this Central Maui Wastewater Reclamation Facility study involves a general overview of State and County plans, policies, land use controls, and environmental laws which will need to be considered in the evaluation of future wastewater treatment alternatives. This report will describe land use, regulatory, and environmental requirements as they relate to new capacity alternatives identified by the County and the Core Working Group.

B. Assumptions

Since the scope and location of wastewater treatment alternatives are not specific at this time, this report describes governmental requirements in a general land use context. This report is limited to the applicability of governmental permitting requirements and does not include cost of permitting, land acquisition or operations.

II. ALTERNATIVES

The following new capacity alternatives were identified by the County and the Core Working Group:

1. Expand the existing Wailuku/Kahului Wastewater Reclamation Facility (WWRF) for future wastewater capacity demands as required. A variation of this alternative includes replacing existing effluent injection wells with deep ocean outfall.

2. Maintain existing WWRF; construct satellite WWRF for future capacity.

3. Maintain existing WWRF; develop smaller individual wastewater systems for future capacity.

4. Phase out existing WWRF; construct new WWRF for existing and future flows.

5. Build new WWRF for future flows and relocate existing WWRF away from shoreline.

6. Do Nothing.

7. Introduce Kanaha Pond for polishing treatment process/reclaimed effluent

III. REGULATORY ASSESSMENT

The following regulatory requirements generally assess Alternatives 1 through 5 as stated above:

A. State Land Use District

Chapter 205, Hawaii Revised Statutes, relating to the Land Use Commission, establishes the four (4) major land use districts in which all lands in the State are placed. These districts are designated “Urban”, “Rural”, “Agricultural”, and “Conservation”.

The existing WWRF is located within the State Conservation District. Lands within the Conservation District fall within the purview of the Department of Land and Natural Resources. As such, the existing facility is not zoned by the County. On April 9, 1980, the Governor of the State of Hawaii, through Executive Order No. 3006, set aside the subject property for sewage treatment plant purposes and vested control and management of the property with the County of Maui. In keeping with this Executive Order, any expansion activity will require a Conservation District Use Permit obtained from the Board of Land and Natural Resources.

Should a new WWRF be located within “Urban” designated lands, County zoning would regulate the uses permitted within a given district. Should a new WWRF be located within “Agricultural” designated lands, then a Land Use Commission, Special Use Permit would be required pursuant to Section 15-15-95, Hawaii Land Use Commission Rules. The authority for granting a Special Use Permit within the Agricultural District is the Maui Planning Commission for an area less than 15 acres, and the State Land Use Commission for an area greater than 15 acres. The Department of Planning should be consulted with for specific permitting requirements.

B. General Plan

The Maui County General Plan (1990 Update) sets forth broad objectives and policies to help guide the long-range development of the County. As stated in the Maui County Charter,

> *“The general plan shall indicate desired population and physical development patterns for each island and region within the county; shall address the unique problems and needs of each island and region; shall explain the opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns, and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies, and implementing actions to be pursued with respect to population*

> *density, land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design, and other matters related to development."*

The following objective of the General Plan relates to Liquid and Solid Wastes:

> *"To provide efficient, safe and environmentally sound systems for the disposal and reuse of liquid and solid wastes."*

C. Community Plan

There are nine (9) Community Plan regions established in the County of Maui. Planning for each region is guided by the respective Community Plans, which are designed to implement the Maui County General Plan. Each Community Plan contains recommendations and standards which guide the sequencing, patterns and characteristics of future development in the region.

The Wailuku-Kahului Community Plan designates the existing WWRF for "Public/Quasi-Public" use, with a strip of approximately 100 feet along the shoreline designated for "Park" use. The existing WWRF is a compatible use within the "Public/Quasi-Public" designation. Also, since no existing building or facility structures are located within 145 feet of the shoreline, this area would be compatible with the "Park" designation.

Specific recommendations of the community plan area include the following:

- *"Investigate the feasibility of constructing a wastewater treatment facility for the Central Maui area to service the future needs of population growth. Locations to be investigated include the airport area, the Puunene sugar mill area, and other areas east of Kuihelani Highway. Site conditions to be evaluated shall include, but not be limited to, potential odor problems with surrounding neighborhoods, corrosive environments, effluent disposal, groundwater contamination and project cost."*

- *"Relocate the Kahului Wastewater Treatment Plant out of the tsunami zone."*

The Department of Planning should be consulted to secure a determination of consistency between the proposed alternatives and the Community Plan recommendations and applicable Community Plan land use designation. Depending on the proposed action and project location, a Community Plan Amendment may be required.

D. Zoning

Maui County Code, Title 19 Zoning, regulates the standards of development within each zoning district. These include standards such as height, density, massing, size, off-street parking, yard area, open space, density, and use of buildings, structures and lands to be utilized for agricultural, industrial, and commercial or any other purpose.

If a proposed action is not determined to be a permitted use in a given zone, a County Special Use, Conditional Use, or a Change in Zoning may be required. The Department of Planning should be consulted for specific zoning requirements for each WWRF Alternative.

E. Special Management Area (SMA)

Title MC-12 Department of Planning, Subtitle 02 Maui Planning Commission, Chapter 202, "*Special Management Area Rules*", are the rules set forth pursuant to Hawaii Revised Statutes, Chapter 205A, "*Coastal Zone Management*", Part II, "*Special Management Areas*". The purpose of these rules is to preserve, protect, and where possible, restore the natural resources of the coastal zone.

Since the existing WWRF is located within the SMA boundaries, any expansion to the existing WWRF for future wastewater capacity (exceeding a valuation of $125,000), would require a SMA Use permit. This permit is processed by the Maui Planning Department and final discretionary action is taken by the Maui Planning Commission through a public hearing process. It is noted that a SMA permit cannot be processed if the proposed action is not consistent with the general plan, community plan, and zoning.

It is further noted that in October 2001, a SMA Use Permit was granted by the Maui Planning Commission for modifications to the WWRF. Condition No. 14 stated the following:

- *"That the Applicant shall incorporate coastal erosion data in future planning for the relocation of the Wailuku-Kahului Wastewater Reclamation Facility. That prior to the issuance of a Certificate of Occupancy, the development of a coastal erosion hazard mitigation strategy shall be initiated by the Applicant."*

Any WWRF Alternative located within the SMA boundaries would also be subject to said rules. The Department of Planning should be consulted for specific SMA requirements.

F. Shoreline Setback

Title MC-12 Department of Planning, Subtitle 02 Maui Planning Commission, Chapter 203, "*Shoreline Rules for the Maui Planning Commission*" are rules set forth pursuant to Hawaii Revised Statutes, Chapter 205A, "*Coastal Zone Management*", Part III, "*Shoreline Setbacks*". The purpose of these rules is to regulate the use and activities of land within the shoreline environment in order to protect the health, safety, and welfare of the public by providing minimum protection from known coastal natural hazards; and to ensure that the public use and enjoyment of the shoreline resources are preserved and protected for future generations.

The shoreline setback for the existing WWRF is approximately 134 feet from the shoreline, based on an earlier shoreline certification survey. The closest existing structures are located approximately 145 feet from the shoreline.

If expansion improvements, including possible shoreline armoring, are located within this shoreline setback area, a Shoreline Setback Variance (SSV), would be required. Similar to the SMA requirements, this SSV is processed by the Maui Planning Department and final discretionary action is taken by the Maui Planning Commission through a public hearing process. Use within the shoreline area which are subject to a SSV, would also be a trigger for compliance with Chapter 343, Hawaii Revised Statutes.

Any WWRF Alternative located within the shoreline setback area would be subject to said rules. A new shoreline certification will be required for the SSV application. The Department of Planning should be consulted for specific shoreline setback requirements.

G. Chapter 343, HRS

Chapter 343, Hawaii Revised Statutes, is the State of Hawaii's environmental impact statement law. This chapter establishes a process for environmental impact disclosure. Applicable triggers for compliance with Chapter 343 may include:

- Use within any land classified as Conservation by the State Land Use Commission;
- Use of State or County lands or funds;
- Use of the Shoreline Setback Area; or
- Proposed wastewater facilities, except an individual wastewater system or a wastewater facility serving fewer than fifty single-family dwellings or the equivalent.

Where there are multiple triggers (e.g., use of County funds in the State Conservation District), coordination between the applicable authorities is required to establish the appropriate accepting and determination entity.

The applicability of Chapter 343 may also be assessed in the context of the Exemption List for the County of Maui, which was accepted by the State Environmental Council (1995). This list categorizes specific actions having minimal or no significant effects on the environment and are declared exempt from the preparation of an environmental assessment or environmental impact statement.

Depending on the extent of the project's potential impacts on the environment, either an Environmental Assessment or an Environmental Impact Statement may be required. The selected accepting and determination agency and the State Office of Environmental Quality Control should be consulted with for specific requirements.

H. Related Studies and Reports

Depending on the extent of the proposed action and project location, the following studies may be required to complete the applicable permit applications (i.e., SMA, SSV, Environmental Assessments).

- Archaeological Inventory Survey;
- Cultural Assessment report;
- Coastal Engineering Assessment,
- Water Quality Assessment;
- Flora/Fauna Study;
- Traffic Assessment;
- Engineering Report (public facilities and services);
- Drainage Report;
- Noise and Air Quality Studies; and
- Community Outreach report.

I. Other Governmental Approvals/Requirements

According to the Flood Insurance Rate Map, the existing WWRF is located within Zone V23 with base flood elevation of 17 to 23 feet. "V" designated zones include areas subject to 100-year coastal flooding with velocity (wave action). The base flood elevation for the property reflects a maximum height of 20 feet. All new construction must be designed and constructed in accordance with the Maui County Code, Chapter 19.62 Flood Hazard Areas. The

Department of Planning should be consulted with for flood hazard designations and applicable requirements for each WWRF Alternative.

Other governmental approvals pertaining to construction include, but are not limited to, grading permit, building permit, electrical permit, and plumbing permit.

Other governmental approvals pertaining to injection wells, use of Kanaha Pond (Alternative 7), and ocean outfalls may include, but are not limited to complying with requirements of the Environmental Protection Agency, U.S. Fish and Wildlife Service, Department of Health, and the Army Corps of Engineers. These agencies should be consulted with for specific permitting requirements.

IV. SUMMARY

Since the scope and location of WWRF Alternatives are not specific at this time, this regulatory assessment on governmental requirements is formatted in a general land use context. When a preferred WWRF Alternative is defined, a more detailed assessment can be made with consultation with various governmental agencies. It is noted that governmental requirements are generally identified by these agencies during the early consultation phases of project planning.

Depending on the complexity of the project, permit processing may range from ten months to two years. Land use entitlement may range from as little as twelve months to more than two years.

FINANCIAL PLAN

FINANCIAL PLAN

I. Introduction

One of the important elements of the CMWWRF Study is to determine the financial impact of recommended system upgrades on the users and how the resulting financial obligations will be met. The purpose of this Alternative Financing section is to provide a summary of current County financial options and financing mechanisms for its wastewater system, to summarize and evaluate alternative financing programs that the County currently does not utilize, and to provide some pertinent preliminary recommendations.

Topics to be addressed are:

- Current County Resources
- Summary of Utility Funding Trends
- Summary of Utility Financing Mechanisms
- Menu of County Financing Mechanism
- Preliminary Recommendations.
- Rate Payer Impacts

II. Current County Resources

The primary sources of revenues for the County's wastewater system are sewer user fees and sewer assessments.

A. Sewer User Fees

The County's primary resource of support for all wastewater operating and capital expenditures is revenue generated through sewer user charges. The current sewer rates by customer class are shown below. These rates are effective July 1, 2005.

Table 1
Sewer User Fees by Customer Class
(Effective July 1, 2005)

Customer Class	Monthly Base Charge (per dwelling unit)	Water Usage Charge (per 1,000 gallons)
Single family	$17.00	$1.95 (applies to first 9,000 gallons)
Multi-family	$17.00	$1.95 (applies to first 6,000 gallons)
Haliimaile	$7.30	none
Residential Care Homes	$49.50	none
Single Family (private water system)	$31.50	none
Multi-Family (private water system)	$26.75	none
Commercial/Government/Religious	$9.50	$3.25 for single meter; $4.05 for dual meter
Hotel	$9.50	$4.65 for single meter; $5.80 for dual meter
Industrial/Food Service/Restaurant	$9.50	$5.55 for single meter; $6.95 for dual meter

Notes:
(1) Dual meter rate is for customers with separate irrigation meters. Fee applied to domestic water meter only, not the irrigation meter.
(2) The County also provides cesspool and septic tank pumping service in non-sewered areas.

B. Sewer Assessments

The County currently imposes sewer assessment fees on developers before the issuance of building permits for those developments which will utilize expansion capacity in the Wailuku/Kahului wastewater treatment system or the Kihei regional wastewater treatment system and for those developments which will create additional impact upon the Kihei wastewater transmission system.

Activities in the Sewer Assessment Fund, including sewer assessment revenues for the last three fiscal years are shown on the Table 2 below.

Table 2
Sewer Assessment Fund
Statement of Revenues, Expenditures and Changes in Fund Balance

	2004	**2003**	**20002**
REVENUES			
Assessments	$1,526,081	$1,176,770	$ 927,595
Total Revenues	1,526,081	1,176,770	927,595
EXPENDITURES			
Expenditures	0	0	0
Total Current Expenditures	0	0	0
Excess of Revenues over Expenditures	1,526,081	1,526,081	927,595
OTHER FINANCING SOURCES (USES)			
Operating Transfers Out:			
Special Revenue Funds	(1,150,000)	(987,255)	(1,594,239)
Total Other Financing Sources (Uses)	(1,150,000)	(987,255)	(1,594,239)
Net Change in Fund Balances	1,038,106	(2,876,071)	(119,532)
Fund Balances, Beginning of Period	376,081	1,434,252	2,100,896
Fund Balances, End of Period	$1,999,848	$1,623,767	$1,434,252

C. Wastewater Fund

Table 3 shows revenues, expenditures and changes in fund balance of the Wastewater Fund for the last three fiscal years.

Table 3
Wastewater Fund
Statement of Revenues, Expenditures and Changes in Fund Balance

	2004	**2003**	**2002**
REVENUES			
Licenses and Permits	$ 9,895	$ 24,095	$ 11,335
Charges for services	23,934,347	21,246,763	21,238,940
Fines & Forfeitures	37,300	1,250	2,650
Assessments	19,072	27,043	36,123
Total Revenues	24,000,614	21,299,151	21,289,048
EXPENDITURES			
Current Expenditures	13,537,585	13,746,435	14,356,420
Total Expenditures	13,537,585	13,746,435	14,356,420
Excess of Revenues over Expenditures	10,463,029	7,552,716	6,932,628
OTHER FINANCING SOURCES (USES)			
Transfers In:			
Special Revenue Funds (Sewer Assessment)	1,150,000	987,255	1,594,239
Capital Projects Fund		107,186	
Transfers Out:			
General Fund (for debt service)	(9,627,220)	(9,183,781)	(8,181,399)
Special Revenue Funds	(847,703)	(839,447)	(110,000)
Capital Projects Fund	(100,000)	(1,500,000)	(355,000)
Total Other Financing Sources (Uses)	(9,424,923)	(10,428,787)	(7,052,160)
Net Change in Fund Balance	1,038,106	(2,876,071)	(119,532)
Unreserved Fund Balances, Beginning of Period	536,721	3,382,671	3,502,203
Unreserved Fund Balances, End of Period	$1,574,827	$ 506,600	$3,382,671

III. Summary of Utility Funding Trends

Nationwide, funding for sewer operations, maintenance and capital projects come from the following sources:

A. Sewer Rates & Charges

Sewer rates and charges to users of the system are the largest sources of revenues. Generally there is a base rate, plus a volume charge.

B. Systems Development Charge (SDC)

An SDC is a charge to developers and is intended to reflect the increased capital costs incurred by a utility as a result of a development. The County's Sewer Assessments would fall into this category. The City and County of Honolulu's SDC is called System Facilities Charges.

The purpose of SDC is to charge a new customer an equitable share of the overall infrastructure costs of providing sewer service. Generally assessed when a customer first connects to a utility system, a connection charge covers the capital costs of providing service to the customer but it does not include any component associated with operation and maintenance expenses. Furthermore, charges for future capital costs can only be assessed for those improvements that increase the capacity of the system. Renewal or replacement expenses are not included as part of a connection charge.

An SDC is normally determined after an update to a utility's master plan has been completed. A properly completed master plan will provide guidance for making a determination whether funds are intended for expanded or excess capacity or for renewal and replacement of existing infrastructure.

C. Local Improvement District (LID) Assessments

LIDs are special assessments levied on property owners for neighborhood public facilities and services, with each property assessed a portion of total project cost. Typical improvements made through the LID process are streets, water lines, sewer lines, sidewalks, and traffic signals. The justification for such levies is that many of these projects provide services to or directly enhance the value of nearby land, thereby providing direct financial benefits to its owners. Rules regarding LID formation, procedures, etc. will vary from one municipality to another. Generally, LIDs are formed when property owners petition the municipality for the purpose of constructing and funding public improvements in their neighborhood or a Local Improvement District may be formed when the municipality determines that improvements are necessary.

D. Grants

The Community Development Block Grant (CDBG) administered by the U.S. Department of Housing and Urban Development (HUD) provides approximately $2 million annually to County of Maui to distribute to private non-profit entities, government agencies and community-based organizations. Eligible activities include, but are not limited to, real property acquisition, public facilities and improvements, etc. Activities funded by CDBG must meet one of the following national objectives: 1) principally benefit low and moderate-income persons and families, 2) aid in the prevention or elimination of slums or blight, or 3) urgent needs (serious threat to community health or welfare). Some of the County's wastewater projects could be eligible for CDBG funding.

The Rural Economic and Community Development Administration (RECD) provides direct loans or loan guarantees to develop water and wastewater system, including storm drainage, in rural areas and to cities and towns with a population of 10,000 or less. Funds are available to public entities and to non-profits. Priority are given to public entities, in areas with less than 5,500 people, to restore a deteriorating water supply, or to improve, enlarge, or modify a water facility or an inadequate waste facility. Applicants must be unable to obtain funds from other sources at reasonable rates and terms.

RECD also provides grants whose purpose is to reduce water and waste disposal costs to a reasonable level for users of the system. Grants may be made, in some instances, up to 75 percent of eligible project costs. Eligible applicants are the same as for loans.

During the late 1970s and 1980s, significant Federal grant funds were available to support wastewater capital projects. Since then, grant funding has been dramatically reduced and currently is not a viable option for capital financing. The Federal grant program has been replaced by the State Revolving Fund (SRF) loans.

Some states provide grants and loans to communities for infrastructure projects that will create additional jobs or stimulate the local economy.

E. Miscellaneous

In some communities where growth is exploding and local government cannot undertake public projects quickly enough, it may enter into an agreement with a developer to pay for infrastructure improvements, and then the developers are reimbursed later from Systems Development Charges.

Others localities may provide some subsidy of the sewer system through general fund support.

IV. Summary of Utility Financing Mechanisms

A variety of financing mechanisms are used nationwide to finance utility projects. These include:

- Sewer revenue bonds
- State Revolving Fund (SRF) loans
- Tax-backed bonds (general obligation, limited tax obligations, etc.)
- Loans through various state loan programs

Nationwide, the most prevalent form of sewer system financing are sewer revenue bonds, followed by SRF loans.

Other potential financing mechanisms include:

- Tax Increment Financing
- Certificates of Participation
- Municipal Lease Financings
- Privatization

In the State of Hawaii, with the exception of the City and County of Honolulu, counties generally rely on SRF loans and general obligation debt. The City and County of Honolulu ("Honolulu") is the only entity to issue sewer revenue bonds.

Honolulu treats its sewer system as an enterprise fund. Revenues of the system in FY 2004 are $115 million. Since 1999, Honololu has issued $706 million of sewer revenue bonds. Honolulu's outstanding sewer system debt as of June 30, 2004 is approximately $48 million of general obligation bonds, $83.5 million of SRF loans, and $677.7 million of sewer system revenue bonds. All sewer system debt, including general obligation bonds, is paid from the sewer system revenues.

The County of Kauai treats its sewer system as an enterprise fund. Revenues of the system in FY 2004 are $6.2 million. Kauai's outstanding sewer debt as of June 30, 2004 is approximately $8.7 million, which are SRF Loans.

The County of Hawaii (the "Big Island") treats its sewer system as a governmental fund. Annual system revenues are approximately $6 million. The Big Island's has approximately $30 million of SRF Loans.

A. State Revolving Fund (SRF) Loans

Under Title 6 of the 1987 Clean Water Act, states receive federal monies to capitalize Clean Water State Revolving Loan Fund (CWSRF) programs. States must provide a match to the federal funds. In the State of Hawaii, the SRF program is administered by the Department of Health (DOH). DOH has estimated that for the fiscal year ending 2005, SRF will have approximately $27.9 million of available funding resources.

Many municipalities rely of the SRF Program to finance their wastewater improvements. The SRF Loans provide below market interest rate loans, and favorable terms. Availability of funds on a timely basis would be the biggest concern.

B. Sewer Revenue Bonds

Sewer revenue bonds represent the most frequently-used financing mechanism for funding capital projects nationwide. Sewer revenue bonds are secured by the net revenues of the sewer system, a debt service reserve funds, and additional covenants. Net revenues are generally defined as gross revenues of the system less operating expenses.

To ensure reasonable interest rates, issuers are required to generate net revenues equal to annual debt service plus an additional amount referred to as debt service coverage. The industry standard for coverage is currently approximately 25 percent of debt service. Because SDCs are unstable, they are often excluded from calculations of debt service coverage. Feasibility studies may be required for first-time issuers, or at the start of a large capital program. Revenue bonds are generally given a rating that is lower than the issuer's general obligation bonds, resulting in a more expensive financing.

Municipalities overwhelming use revenue bonds to fund sewer projects for the following reasons:

- Many sewer systems are enterprise systems, operated on the principle that the sewer system should be self-sufficient.
- Obtaining voter approval, which are often required for general obligation bonds sometimes be difficult.
- Revenue bonds are not subject to other requirements of general obligation bonds, such as debt ceiling limitations, and restriction regarding use of bond proceeds.
- The desire to preserve general obligation bonds for other projects which revenue bonds would not be feasible.

C. General Obligation Bonds

General obligation bonds are backed by the full faith and credit of the issuing government, with the guarantee that the issuer will use its taxing power to repay the bonds if necessary. General obligation bonds, backed by full taxing power, are regarded as safer than bonds backed by a single revenue source. They generally command lower interest rates and have no reserve fund requirements. General obligation bonds provide structural flexibility since the issuer can pay the bond with a variety of revenue sources. In most localities, general obligation bonds require a vote of the people, and are subject to constitutional or statutory limits.

Most municipalities that finance sewer projects with general obligation bonds, including the County, pay the debt service from system revenues and do not levy taxes to pay the debt service. The general obligation pledge is used as a mechanism to obtain the lowest cost of financing possible.

Nationwide, there has been a movement away from issuing general obligation bonds for sewer systems. This is because in many localities voter approval is needed for such bonds and issuers also want to preserve the general obligation mechanism for other projects where revenue bonds would not be feasible. Many do not want to have the general obligation bond count against their debt limitation.

Rating agencies generally subtract general obligation bonds from the issuer's debt load if it is demonstrated that the sewer revenues will pay the debt service.

D. State Loan Programs

Numerous states have loan programs that provide assistance to localities for financing infrastructure of other projects. Many of these programs operate as revolving funds, meaning that the programs are at least partially financed by repayment of earlier loans. The purpose of these programs is to provide communities (especially smaller communities) access to financial markets to finance projects at lower rates

The eligibility requirements and attractiveness of the state loan programs vary. Some states have revenues from lottery funds, taxes, or revenues to pledge as additional security or to subsidize the cost of the financings. In the absence of these subsidies, these programs are still attractive for many smaller issuers who benefit from having bonds issued in a pool versus issuing their individual smaller bonds.

E. Special Assessment Bonds

Special Assessment Bonds are secured by assessments. The bonds are sold to finance specific public infrastructure improvements that directly benefit property owners in limited, identifiable areas. Depending on the strength of the assessments, a back-up pledge of other taxes or revenues may be necessary.

F. Tax Increment Financing

Tax Increment Financing (TIF), is a tool used for redevelopment projects. Property taxes within a TIF district are frozen at a baseline level. The difference between the baseline tax assessment and the taxes that would otherwise be assessed on an improved property is the “tax increment,” which goes to the TIF district. The TIF district can borrow against the anticipated incremental increase in property taxes to make improvements to the district, including sewer projects.

Depending on local law, TIF may require voter approval and the creation of special districts. Tax increment bonds require effective administrative systems for property value tax accounting that may be costly and complicated to manage over time. TIF bear higher interest rates than general obligation and revenue bonds and also require a debt service reserve.

G. Certificates of Participation

In a Certificate of Participation (COPs) arrangement, a municipality enters into a lease agreement to pay lease payments to a third party lessor. The lessor raises funds through the sale of COPS to investors, which provides funds to purchase the asset. The lease agreement is divided and sold to multiple investors in fractions, usually $5,000 denominations. Each certificate represents a fractionalized or proportional interest in the rental payments that will be made by the issuer. The lessor assigns all of its rights, title and interest in the lease, including the rights to receive lease payments, to a trustee under a trust agreement. The trustee holds title to the leased asset. During the lease term, title may be vested in the name of the municipality, with the lessor retaining a security interest in the asset. Upon full repayment, ownership of the asset is transferred to the municipality. If, however, the municipality defaults on its lease payments, the trustee is responsible for selling the asset and using the sale proceeds to reimburse the certificate holders.

Lease payments are subject to annual appropriations. Not all states allow COPs. Generally, COPS do not require voter approval and do not count toward a municipality’s debt limitations.

COPs bear a higher interest rate than General Obligation or Revenue Bonds because they are considered a riskier investment; in any given year a municipality can terminate the lease without being considered in default. In addition, there is a reserve requirement, and are generally more expensive to issue than bonds due to the involvement of a third party.

H. Municipal Lease Financing

Municipal leases are structured as a series of one-year renewable obligations that are subject to the municipality’s ability to appropriate funds for making these lease payments. The municipality who seeks to acquire the particular property is the lessee. Generally the lessor is an independent leasing company, a trustee bank, a state agency, or an authority. The lessee generally grants the lessor, or a trustee as assignee of the lessor, title or a first lien on the lease property for the life of the financing. In the event the municipality chooses to exercise its right of non-appropriation, the lessor has the right to take possession of the leased asset. Like COPs, leases do not require voter approval, and are not counted toward a municipality's debt limit. Lease obligations do not bear the same legal protections as general obligation or revenue bonds, and therefore the interest costs associated with leases are higher.

I. Privatization

Competitive contracting for operations, design/build, and asset sale are some of the ways that municipalities can involve the private sector to reduce costs or to shift the responsibility of financing to a private partner. Day-to-day operations are contracted out to qualified operators for defined periods of time. Under Design/Build, both the design of the facility and the construction are performed by the same business entity. With an important variant, Design/Build/Operate, a municipality solicits a single bid for the construction of the project and for its subsequent operation. Privatization via the sale of sewer assets to the private sector is one way of relieving the government of the burden of infrastructure expansion and service delivery. It also produces an infusion of cash to the municipality that sells the asset.

Proponents argue that such arrangements generate savings from competition and efficiency. Opponents argue that the provision of essential services should remain within the domain and control of the municipality and that the profit motive of a the private sector could drive prices higher in the future, and that unless such arrangements are structured very carefully, they would not be able to benefit from the issuance of tax-exempt financing. The ability of a municipality to enter such arrangements is often limited by laws and regulations.

J. Variable Rate Debt

Some larger municipalities issue a portion of their debt as variable rate debt which can help lower the cost of borrowing and provide a hedge against interest rate risk. Interest rates on variable rate debt instruments are at the short end of the yield curve because they are periodically adjusted (e.g., daily, weekly monthly) based on current market conditions. Issuers can also achieve the benefits of variable rate debt through fixed-to-floating interest rate swaps. Variable rate debt will require more daily management and a thorough understanding of the risks involved.

V. Menu of County Financing Mechanism

A. SRF Loans

The County is eligible to participate in the SRF Program. As of June 30, 2004, the County has $31.1 million in outstanding SRF loans, which bear interest at 3.34% to 3.60%.

Interest rate on SRF loans are set at 2/3 of the bond rate as indicated in the most recent publication of "The Bond Buyer", less 1%. Counties also pay a 1% loan fee based on the outstanding loan balance. SRF loans represent the lowest cost of financing for the County.

B. General Obligation Bonds

General obligation bonds are secured by a pledge of taxes and the full faith and credit of the County. The County may issue general obligation debt without a vote of the people. The State Constitution limits the amount of general obligation debt a government entity may issue to 15% of its total assessed valuation. The debt limitation for the County is $2.98 billion. As of June 30, 2004, the County's outstanding general obligation debt represents only 8% of its debt limitation.

The County's General Obligation Bonds are highly rated. They are rated AA- rating by Standard & Poor's and Fitch, and Aa3 by Moody's Investors Service

As of June 30, 2004, the County has $193.1 million of general obligation debt. A portion of this debt is allocated to the wastewater system, and is paid from revenues of the Wastewater Fund.

C. Revenue Bonds

The County has the option to issue sewer revenue bonds to fund its sewer improvements. The County debt has traditionally consisted of general obligation bonds or SRF loans. However, the County is considering issuing revenue bonds to fund capital projects of the Department of Water Supply.

From a cost stand-point, revenue bonds will be more expensive than general obligation bonds. In addition, revenue bonds will require either funding a debt service reserve through cash, bond proceeds, or the purchase of a surety bond. Revenue bonds will also involve entering into covenants with bondholders regarding maintaining a certain level of rates and charges, and other restrictive covenants.

Table 4 below shows three hypothetical financings which would provide $50 million for projects. It shows that the SRF Loan is the lowest cost alternative, followed by general obligation bonds, then revenue bonds.

The interest rate levels are based on current market conditions for fixed-rate debt amortized over 20-years. Note that it would not be realistic to expect that the SRF program would provide $50 million of loans to the County in any one year. The revenue bond scenario assumes that the County would purchase a surety bond in lieu of funding the debt service reserve fund by cash or bond proceeds.

Table 4
Summary of Financing Alternatives
(assuming 20-year level debt service)

	SRF Loan	GO Bonds	Revenue Bonds
Par Amount	$ 50,000,000	$ 50,660,000	$ 50,890,000
True Interest Cost	3.60%	4.28%	4.43%
Total Debt Service	$ 70,916,000	$ 75,426,000	$ 76,443,000
Average Annual Debt Service	$ 3,545,800	$ 3,771,300	$ 3,822,150

D. Other

The other types of financing mechanism such as leases, certificates of participation, tax increment financings, privatization, and variable-rate debt all require further legal and financial analysis to determine whether the County can legally enter into those arrangements, the financial costs, the advantages and disadvantages of such arrangements.

VI. Preliminary Recommendations

The County's success in implementing its wastewater capital plan is dependent upon its ability to generate sufficient cash flow from the operation of its sewer system to pay future debt service.

The following Table 5 shows the estimated debt service for the Wastewater Fund. This includes the 2005 GO Bonds which were recently issued, and anticipated 2005 SRF Loans in the amounts of $3.33 million and $7.6 million.

Table 5
Estimated Outstanding Debt Service- Wastewater system

FY Ending	GO Bonds Debt Service	SRF Loan Debt Service	Total Debt Service
2006	$6,785,527	$3,844,165	$10,629,692
2007	6,821,319	3,836,219	10,657,538
2008	6,289,789	3,828,074	10,117,863
2009	5,353,340	3,819,728	9,173,068
2010	4,679,242	3,811,165	8,490,407
2011	4,683,587	3,796,834	8,480,421
2012	3,115,327	3,737,878	6,853,205
2013	3,118,897	3,716,641	6,835,538
2014	2,314,072	3,151,718	5,465,790
2015	1,178,056	2,832,700	4,010,756
2016	999,056	2,819,848	3,818,904
2017	1,011,056	1,975,036	2,986,092
2018	1,011,056	1,856,560	2,867,616
2019	1,000,308	1,701,670	2,701,978
2020	777,995	1,694,295	2,472,290
2021	755,206	1,570,926	2,326,132
2022	254,206	1,476,971	1,731,177
2023	84,825	1,080,163	1,164,988
2024	84,825	637,000	721,825
2025	-	637,000	637,000
	$50,317,689	$51,824,592	$102,142,281

Because SRF loans represent the lowest-cost of funds, SRF loans should be the first financing mechanism that the County uses. In the absence of SRF loans, general obligation bonds would be the second best option for the County, as they represent the next lowest-cost of funds after SRF loans, and do not require a debt service reserve fund, debt service coverage, or other restrictive covenants. If sewer system capital needs require more than $150 million in debt, the County should engage in conversations with rating agencies to determine whether such a debt load would negatively affect the County's general obligation bond ratings, and whether a revenue bond program would be preferable.

From the financial statements of the last three fiscal years, the County's Wastewater Fund does not generate much excess net income from operations after debt service. Fund balances in both the Wastewater Fund and the Sewer Assessments are relatively small, totaling $3.6 million as of June 30, 2004.

Given that the wastewater capital program could exceed $100 million under certain alternatives, a formal financial plan should be undertaken. This plan should result in a multi-year financial forecast and cash flow projection, which would project revenues, operating expenses, capital needs, debt service and reserves. While there is no requirement that the County calculate debt service coverage so long as there are no revenue bonds issued, it may consider doing so for planning purposes. The plan would identify the funding and financing sources for capital improvements, including a phasing plan. The plan would also review the specific proposed capital projects to identify whether certain projects would be eligible for grant funding. In addition, the plan would review the applicability of non-traditional financing mechanisms to the County's situation.

Such a plan would help the County to spread capital costs over time providing for reasonable increases in user rates and equity among current and future ratepayers, and across user classes.

VII. Rate Payer Impacts

The user fee impact to the single family customer range from a low of $87.82 per billing cycle to a high of $198.26 per billing cycle based on the alternatives selected. The rate impact date varies based on the respective alternative planned start date. A summary of the user fee impacts and start dates are presented in Table 6. The base user fee per billing cycle for the status quo is $76.82 for 2008, $81.50 for 2010 and $99.12 for 2020.

The County's assumption in developing the user fee's is to float GO bonds for Alternative 1 and Revenue Bonds for all other alternatives. This decision is driven by the County's GO bond ceiling limitations and the potential negative impact on the County's bond rating.

Table 6
Estimated User Fees

Alternative	Alternative Description	Proposed User Fee/Year
1	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Injection wells for disposal.	$87.82/2009
2	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Brackish groundwater recharge for disposal.	$165.06/2020
3	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Water recycling for disposal.	$179/2020
4	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Injection wells for disposal.	$163.06/2020
5	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Brackish groundwater recharge for disposal.	$181.88/2020
6	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Water recycling for disposal.	$198.26/2020
7	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Brackish groundwater recharge for disposal.	$103.86/2010
8	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF. Ocean outfall for disposal.	$195.22/2020

Alternative	Alternative Description	Proposed User Fee/Year
9	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Ocean outfall for disposal.	$108.58/2010
10	Construct a new Central Maui WWRF to meet future wastewater treatment needs and relocate the existing Wailuku/Kahului WWRF away from tsunami and shoreline erosion zones. Injection wells for disposal.	$181.88/2020
14	Expand the existing Wailuku/Kahului WWRF and fortify facility to protect against tsunamis and shoreline erosion. Water recycling for disposal.	$103.86/2010

APPENDIX A

CORE WORKING GROUP MEETING MINUTES

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS ● SURVEYORS

Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 3/25/04

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 3/25/04

The first meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group was held at 5:00 on March 25, 2004 in the Maui County Planning Conference Hearing Room.

The following lists individuals who were present at the meeting:

Dale Bonar

Grant Chun, Alexander & Baldwin

Lani Correa, Maui Hotel Association

Lucienne deNaie, Sierra Club

Arnold Garzino, alternate for Mitchell Nishimoto of First Hawaiian Bank

Steve Holaday, Hawaiian Commercial & Sugar

Charlie Jencks, Maui Contractors Association

Martin Kirk, Hawaii Kiteboarding Association

Jason Koga, State Department of Land and Natural Resources

Clyde Kono, Bank of Hawaii

Sean Lester, Maui Tomorrow

Warren McCord, Maui Outdoor Circle

Judith Michaels, Maui Tomorrow

Leiane Paci, Maui Lani Partners

Ed Reinhardt, Maui Electric Company

George Rixey, Kihei Community Association

Glenn Shepherd, Maui Tomorrow

Ronald Shimizu, alternate for Jay Nakamura of Stanford Carr Developments

Lynne Woods, Maui Chamber of Commerce

Project team attendees included:

Dave Taylor, Project Manager with Maui County Department of Public Works

Eric Nakagawa, Maui County Department of Public Works

Lambert Yamashita, Austin Tsutsumi and Associates

Eassie Miller, Brown and Caldwell

Daren Suzuki, Munekiyo & Hiraga

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Welcome and Introductions

Dave Taylor opened the meeting thanking members for participating in the development of a strategy to meet central Maui's wastewater needs. He introduced Lambert Yamashita, project manager, who then introduced other members of the consultant team. Brief introductions were made whereby participants noted their names and affiliations, as well as interest in the project.

Berna Cabacungan summarized the agenda and stressed that the meeting was an orientation to educate the Core Working Group members about the wastewater system, as well as introduce the group to the approaches that will be used to develop alternatives for Central Maui's wastewater needs.

Project Background and Purpose

The meeting discussion was based on a PowerPoint presentation, a hard copy of which was distributed as a handout. Lambert Yamashita presented the project team organization and mission statement. He then described the general approach that would be used to find alternatives for Maui's wastewater treatment plant. The project's four main components include community participation, planning considerations, financial planning and shoreline issues.

Introduction to Our Wastewater System

Dave covered the preliminary project schedule. He noted that this project purpose is to explore the wide range of options for meeting Central Maui's wastewater needs, and the Core Working Group input will help the team incorporate community values and issues. By the middle of 2005, project recommendations would be submitted to Maui County Council and Council will be asked to pass a resolution that backs one of the alternatives. Ideally, these recommendations would set the direction for future actions, including funding and project implementation.

Current projections indicate that the existing Kahului Wastewater Reclamation Plant may reach capacity some time from 2007 to 2011, and Dave noted that new facilities should be in place by then if we start the process now. The current capacity of the wastewater plant is 7.9 Million Gallons Per Day (MGD).

Dave presented "Wastewater 101", an introductory discussion of what happens to Maui's wastewater as it is treated and transformed into the water that is disposed or recycled. He noted that wastewater treatment basically speeds up the natural waste process. This is done by separating water from waste through a screening process. The waste is then aerated to increase the breeding of organisms. The liquid waste is injected in wells that are at least 350 feet deep. The bio-solids are transferred to landfills.

The following summarizes questions and answers.

Question: How is the Kihei wastewater plant related to the Kahului facility?
Response: Maui's three treatment plants are located in Lahaina, Kihei, and Kahului. There are also private wastewater treatment plants for areas such as the Maui Prince. The Kahului treatment plant serves Waiheu, Wailuku town, Kahului, Sprecklesville and Paia. There is an extensive line system that brings the wastewater and they all converge on the site of the current treatment plant. If a new plant is built, the collections and transmission system needs to be considered in the planning and design.

Question: Do ships in Kahului Harbor have a way to pump out sewage to the wastewater plant?
Response: Harbor facilities are on a separate septic system that is regulated by the State of Hawaii. That system will not be part of this project.

Question: Will areas that are not currently hooked up to the County system be included in this project?
Response: That is not part of this project.

Question: What is the peak capacity of the treatment plant? What is the current rate?

Response: The capacity is measured as a 30-day average, with it being 7.9 MGD of capacity. There are peak times such as during the morning, where it around 7 to 8 MGD; this drops off at night. The current rate is 5.5 MGD and this varies through the year.

Question: What is the holding pond for?

Response: This is an emergency holding tank that is connected to the injection wells. If we don't want to use the wells, we can shut them down and the tank will capture the overflow and send it back through the system.

Question: Does the system have any storm surge in place?

Response: The 7.9 MGD is a dry weather sewage system. The storm drains are not connected to the sewage system. The storm and sewage systems are separate.

Question: If areas begin to use gray-water on site, would this affect the capacity of the plant?

Response: An average house uses 350 gallons per day. If the flow is dropped, it will extend the life of the plant.

Question: How large is this facility's property?

Response: About 10 to 12 acres.

The Core Working Group Role, Function and Process

Berna introduced the Core Working Group role and process. She explained that the project team wants to include community values in the evaluation process, rather than after recommendations are already made. She said that this group is seen as a community base from which communication will broaden because of people's networks. She said that up to 7 meetings are expected and reviewed the general purpose and time frame of each meeting.

Participants agreed that meetings should be held at 4:00 PM on Thursdays. For those who are interested in visiting the Kahului plant, alternative times will be provided. Participants agreed that email was the best way of communication between consultants and members; faxes were the next preference.

Preliminary Guiding Principles

Berna introduced the concept of guiding principles as fundamental statements of community values that guide discussions and actions on this project. She then asked group members to come up with their own guiding principles to start forming a list. The following summarizes the group notes and related discussion:

- Develop a plan that is least disruptive to the ecosystem.
- Fast track new wastewater site selection.

  Comment: It is a waste to put water into injection wells. The water should be used for golf courses or, for example in Kihei, some water is used for growing corn. If the treatment plant is relocated to a higher site, then sites below can used the water.

- ❖ Maximize use of reclaimed water

  Comment: Pump wastewater to Kepoalani Park.

  Comment: Infrastructure for re-use should be a component of the plan itself. The plant should have an in/out plan.

- ❖ Cost effective plan, with integrated cost and benefits.

  Comment: Have long term equal to short term effect.

- ❖ Wastewater and reclaimed water quality and monitoring should remain the County's responsibility

- ❖ Compatible with future technologies

  Comment: The Iao aquifer is overdrawn. Should the old Wailuku Heights be included in the system? *Response:* This is a follow up item.

  Comment: Where do we address or include future construction and should private systems be considered for inclusion? *Response:* The planning and alternatives would be based on adequate acceptable data.

  Comment: What kind of data would be used? Minimal acceptable data or the best quality data? *Response:* In the planning study, the best available data would be used, and as the project goes on, they will look at the quantification of data quality.

- ❖ Reclaimed water is a commodity

Berna will synthesize this information to develop draft guiding principles for review by the Core Working Group.

Introduction to Scenario Planning

Berna said that scenario building will be used to develop evaluation criteria and discuss alternatives. She explained that scenarios are ways to develop imaginative pictures of potential futures, and consist of pictures (stories) and numbers. A good scenario provokes thoughtful discussion and debate, covers a broad range of alternatives, challenges conventional wisdom, and is relevant to participants.

She posed four scenarios for consideration:

- ❖ Zero tolerance for environmental impacts
- ❖ Minimum taxpayer burden
- ❖ Maximum water reclamation
- ❖ Capacity management (restrictive to expansive capability)

She noted that these scenarios should provoke thought and discussion of various alternatives. Some alternatives may be unique to one scenario, whereas others may be common to several. The scenarios are not intended to cancel each other, but rather help people think of many variations and alternatives.

Next Step and Homework

Core Working Group members will be asked to do three things ***by April 16:***

- Review and comment on draft Guiding Principles
- Comment on four preliminary Scenarios
- Submit questions in writing that can be answered in next few meetings.

The next meeting is planned for May 27, at 4:00 p.m.

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS ● SURVEYORS

Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 5/27/04

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 5/27/2004

The second meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group (CWG) was held on May 25, 2004 in the Maui County Civil Defense Conference Room. CWG participants included:

Dale Bonar, Maui Coastal Land Trust

Arnold Garzino, First Hawaiian Bank (former alternate)

Steve Holaday, Hawaiian Commercial and Sugar

Martin Kirk, Hawaii Kiteboarding Association

Warren McCord, Maui Outdoor Circle

Jan Roberson, Surfrider Foundation

Glenn Shepherd, Maui Tomorrow

Project team participants included:

Tracy Takamine, Dept. of Public Works

Dave Taylor, Dept. of Public Works

Eric Nakagawa, Dept. of Public Works

Lambert Yamashita, Austin Tsutsumi and Associates

Daren Suzuki, Munekiyo & Hiraga, Inc.

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Meeting 1 Review

After the first CWG meeting, members were asked to fill out tables containing draft guiding principles and preliminary scenario concepts. Berna Cabacungan reviewed homework results. She presented a revised set of guiding principles, based on CWG comments. These revisions will be distributed to all CWG members for further comment.

Visits to the Kahului Wastewater Reclamation Facility were held as discussed in the first meeting. Six CWG members and one guest participated. There was a request for an additional site visit, and Dave Taylor asked that that members interested in attending to contact him directly, and he would arrange a follow-up site visit.

One CWG member submitted a written question as follows: *It is important to project population growth and design this project to accommodate that growth. Maui's infrastructure has not kept pace with development. This project should break that pattern.* Daren Suzuki replied that the project team is analyzing population projections for this region, and he will present preliminary findings at the next meeting.

Review of Core Working Group Role and Function

Berna noted that the Core Working Group was intended to bring community values and ideas into the identification and evaluation of alternatives for the Central Maui Wastewater Reclamation Facility Master Plan process. Hence, the initial selection of the Core Working Group members was designed to bring both diversity and balance into the process.

She explained that there are three levels of participation. The Core Working Group is the basic building block of community input. There are also representatives from government agencies who are serving as resource and are being asked to attend on an as-needed basis. The third level of participation includes the networks of CWG members. They may attend meetings as observers.

To maintain the balance and diversity of the participation process, CWG members are given priority in discussions and if any straw votes are taken. It was stressed that straw voting may occur in matters related to logistics, but that, to maintain a range of opinions and options in the process, no formal voting will be taken for substantive matters.

Observer participants may participate in discussions after CWG members have fully expressed their views. Meeting summaries will distinguish observer comments.

Glenn Shepherd asked that the resources include a government representative familiar with GIS. He suggested John Guschner from Maui or someone from the UH Geography Department. Lambert Yamashita and Dave Taylor responded the project team will be using GIS. Glenn felt that it would be good to have an outside opinion. It was decided to follow up with Glenn later regarding this topic.

Building Project Scenarios:

Berna explained that scenarios are a combination of visioning and strategic planning. Scenario planning is a way to think about all possible outcomes in the future. A good scenario provokes debate, has a broad range of alternatives, is memorable, and relevant to participant.

Four scenarios were presented in the first meeting, including

- Capacity Management
- Minimum Taxpayer Burden
- Maximum Water Reclamation
- Zero Tolerance for Negative Environmental Impacts.

Glenn asked what triggered this process. Dave responded that the Department Of Public Works wanted to take a broad approach and involve the community in developing alternatives. Glenn asked if this could be tied into water resources. Dave answered that these issues will always be closely related.

Glenn asked if there would be adequate water resources in the future. Dave stated that there will be more demand on water resources with growth, and also an increase in wastewater management that is generated, which is what led to this project. Glenn asked who would make the decision on implementing the plan. Dave explained that alternatives will be looked at in the CWG, and a plan will then be sent to Maui County Council. It is hoped that the County Council will pass a resolution that provides definitive direction to the administration.

As a follow-up to the previous meeting, Glenn gave Dave a 1972 study that analyzes alternative sites and water resources.

Building Project Scenarios

CWG members were given a diagram of scenarios that included, for each scenario, a benchmark for success and possible strategies to achieve success. Four stations were set up around the room and participants broke up into three small groups. They were asked to identify *specific actions to carry out strategies,* and to provide suggestions on post-it notes. Benchmarks, possible strategies and recommended specific actions to carry out strategies are summarized as follows:

Maximum Water Reclamation

Benchmark for Success: By 2020, reclaimed water is commonly used to irrigate the landscaping of public and private property, as well as in agriculture. Further, the County is actively exploring ways to increase the use of reclaimed water.

Possible strategies to achieve success: Technology, locations, user incentives, partnerships, regulations, other?

CWG suggested actions:

- Reclaimed water to: 1. Keopuolingle Park; 2. Kauaka Park; 3. Baldwin Park; 4. A & B Sugar Operations; 5. Maui Lani Golf Course; 6. Waiehu.
- Storage of reclaimed water
- Tax incentives for reclaimed water use
- Incentives for research to purify for home use
- Location needs to be near user
- Storage to handle variable demand and flow rates
- Locate site relative to future land use (i.e. golf courses, resorts, industrial, etc.)
- Use new technology (flexibility)
- Require reclaimed water use by parks, golf courses, agriculture, etc.
- Ban injection wells
- Require hook up of older systems, (cesspool, septic) as new systems are constructed.
- Require dual water systems, recycled for toilets, agriculture, lawn
- Reclaimed water is cheaper to buy than fresh water

Capacity Management

Benchmark for success: In 2020, the Central Maui Wastewater Reclamation System plays a major role in the settlement patterns and population growth of Central Maui. It is operationally capable of expanding capacity as ne4eded, as well as restricting capacity to manage growth in certain areas.

Possible strategies to achieve success: Technology, level of change, partnerships, other?

CWG suggested actions:

- Build expandable plant
- De-centralization of the treatment system for future developments
- No expansions of existing plant promoting the development of smaller communities with smaller plants.

- Long term planning is essential for future decision making process for plant siting and expansion.
- Modular design of treatment systems (technology)
- Siting of treatment system should be sensitive to future land use plan.

Zero Tolerance for Negative Impacts

Benchmark for success: In 2020, the Central Maui Wastewater Reclamation System meets all related Federal, State and County regulations. Further, the community is strongly encouraged to protect and restore the environment in matters related to the wastewater system.

Possible strategies to achieve success: Level of change, technology, locations, operations, user initiatives and incentives, others?

CWG suggested actions:

- Location important as relates to hazards
- Anything mechanical cannot achieve zero tolerance for spills
- “minimize” negative environmental impacts; better wording
- utilizing “best technology” but may be costly
- How is facility operated... contingency or installed redundancy
- Design capacity appropriately sized (pumps and collection system)
- Minimize storm water runoff into system
- “minimize” tolerance; better wording
- “zero” nutrients in reclaimed water
- eliminate injection wells
- use all reclaimed water
- integrated redundancy systems
- Location: facility location away from environmentally sensitive areas
- “zero tolerance” for negative environmental impacts should be immediate
- Location: Away from environmental hazards
- Technology: using reclaimed water (all)

Minimum Taxpayer Burden

Benchmark for success: By 2020, the necessary upgrades and improvements to the Central Maui Wastewater Reclamation System were achieved with only a 5% increase in sewer fees over the previous 15 years.

Possible strategies to achieve success: Level of change, user incentives, user fees, partnerships, technology-based efficiencies, others?

CWG suggested actions:

- Impact fees to cover all construction
- Impact fees to cover increasing operating costs
- Change final uses for bio-solids and reclaimed water

- Timing of effluent- different charges for different times of day
- Locate plants at elevation- so gravity feeds inflow and effluent
- Build closer to ultimate use; lower transmission costs
- Technology to actually meet measure effluent
- Water saving incentives- lower flow
- Most energy efficient technology
- Put near generators
- Get the plant out of tsunami zone
- Tap some federal and state funds
- Use the effluent to run generators
- Some group other than government to run plant more efficiently; privatization
- Mechanization to run plants
- More efficient construction costs
- Combine wastewater treatment and water treatment so that we don't need both
- Utilize new/ efficient technology.

At the end of this exercise, a member from each group explained the suggested specific actions to carry out strategies.

It was asked that, if Maui Lani could put in a lake for reclaimed water, what are security and liability requirements. Lambert responded that it would be under the health department guidelines. Several golf courses use lakes with reclaimed water and signage is used to inform people. Management of the system is key to ensure that the water does not become stagnant.

Berna explained that this was the first brainstorming session, and the results will be made available to comment on. She asked that input be received by June 11. [1]

Next Step

The next meeting will be held on July 15, 2004. Other tentative dates for remaining meetings are as follows:

Meeting 4: September 9, 2004

Meeting 5: November 18, 2004

Meeting 6: January 27, 2005

Meeting 7: March 10, 2005

[1] *This date has since been revised.*

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS ● SURVEYORS

Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 7/15/04

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 7/15/2004

The third meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group (CWG) was held on July 15, 2004 in the Maui County Civil Defense Conference Room. CWG participants included:

Grant Chun; A& B Properties

Steve Holaday, Hawaiian Commercial and Sugar

Charlie Jencks, Maui Contractors Association

John Karrow, Private Consultant (guest)

Jason Koga, DLNR

Mitchell Nishimoto, First Hawaiian Bank

Leiane Paci, Maui Lani

Glenn Shepherd, Maui Tomorrow

Project team participants included:

Tracy Takamine, Dept. of Public Works

Dave Taylor, Dept. of Public Works

Eric Nakagawa, Dept. of Public Works

Eassie Miller, Brown and Caldwell

David Paul, Brown and Caldwell

Lambert Yamashita, Austin Tsutsumi and Associates

Daren Suzuki, Munekiyo & Hiraga, Inc.

Anne-Lise Lindquist, Moffatt and Nichol Engineers

Russell Boudreau, Moffatt and Nichol Engineers

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Meeting 2 Review

Berna Cabacungan reviewed the second meeting highlights. She described the brainstorming process whereby participants divided into three small groups, and each group provided ideas for carrying out strategies for each scenario. She added that the guiding principles are now final and that they will be distributed to CWG members not present at the meeting. She also stressed the importance of responding to the homework to ensure diversity and participation.

Status and Findings of Consultant Teams

County Issues/Constraints and Options/Alternatives

Eassie Miller noted that the consultant team met with the County to discuss 1) issues and constraints and 2) options and alternatives. The following were identified as issues and concerns:

- Public or private partnerships
- Impact on Operation, Maintenance and Repair budget on ratepayers: what impact will user fees have
- Funding sources: impact on other wastewater needs
- Disposal concerns: will continued use of injection wells be allowed by Department of Health?
- Peak wastewater hours: Issues such as heavy rains and increase flow
- Recycled water quality: impacts on users or groundwater
- New facility

- Community buy-in
- Meeting staff requirements for new WWRF
- Wastewater flow distribution: existing vs. new

The following were options identified by the County and the consultant team at that meeting:

- Expand existing WWRF and fortify/ upgrade to deal with the threat of tsunami
- Construct satellite WWRF's while continue to operate existing plant
- Convert to individual wastewater systems- septic or smaller
- Re-direct portion of wastewater flow to new WWRF and keep existing WWRF
- Build new WWRF and abandon existing WWRF
- Implement development moratorium
- Incorporate Kahana Pond to reincorporate and re-use in end

Dave Taylor noted the options identified by the County seemed to mirror the program values and guiding principles of the CWG.

Socio-Economic Projections

Daren Suzuki presented the socio-economic forecast issues. He explained that he reviewed existing studies from the County Planning Department to estimate future wastewater demand and when the capacity of the current facility may be reached. He distributed a handout with the following tables:

- Maui Island De Facto Population (SMS, Socio Economic Forecast, June 2002)
- Maui Island Resident Population Projections (SMS, Socio Economic Forecast, June 2002)
- Wailuku-Kahului Residential Population Projections (SMS, Socio Economic Forecast, June 2002)
- Wailuku-Kahului Average Visitor Census (SMS, Socio Economic Forecast, June 2002)
- Wailuku-Kahului Wastewater Reclamation Facility Projected Wastewater Flows (Baseline Projections) (SMS, Socio Economic Forecast, June 2002; Wilson Okamoto Corporation Infrastructure Assessment Update)

Glenn Shepherd asked for a definition of de facto; Darren responded that it was the total population of tourists and residents.

Steve Holaday asked how much wastewater was generated by businesses. Darren responded that the numbers were based on resident and tourists, but it overlaps with business and population numbers.

Charles Jencks noted that this process is focusing on Wailuku and Kahului wastewater needs, but at one time, there was discussion of a centralized plant, possibly in Puunene; this would also serve Kihei. He asked how the need to relocate would be reconciled. Darren stated that one of the options was relocating the plant to Puunene, but this information focuses on the limits of present capacity.

Darren further stated that Wilson Okamoto did a study of resident vs. visitor populations and projected that the capacity of 7.9 mg/day would be reached by 2015. Charles referred to the second table, with the resident and visitor population at maximum flows, and asked if this was based on straight-line population trends, or if spikes in economic behavior taken into consideration. Darren answered that the SMS study used data from the US census, which is basically straight-line projections. Darren further noted that the population for the County is based on historical trends using numbers taken from existing studies. If new data becomes available it can be plugged in, but it looks like capacity will be reached around 2015.

Charles asked if all the projects on the current project listing would be built out. Darren responded that he was not sure, but that it was provided as information for what other developments may be implemented.

Dave Taylor stated that the projections are not intended to be exact. The numbers do provide some indication, however, of possible timing of when capacity will be reached. This is important so that the County can prepare measures to meet future capacity. Because it takes approximately six to eight years to obtain permits and conduct design, plans need to be done ten years before capacity is reached. We therefore need to make decisions and start the process now.

Glenn noted that a tsunami could cause major damage to the current plant at any time, and they should not wait till 2015. Dave responded that timing depends on the County Council decision. The process is intended to develop options that reflect the values of the community; the County Council would vote on that. Darren added that population predictions include project developments and land use studies. Land use studies look at the available land for growth accommodation.

Glenn asked if it would be applicable to have a tsunami expert participate in this process. Dave Taylor stated that the newer buildings at the plant have been made to specifications of a 100-year tsunami.

<u>*Other Consultant Studies*</u>

Eassie presented PowerPoint slides that depicted development activity on Central Maui and an overview of the service areas. He noted the pump stations would be impacted with development.

Glenn asked it the existing pump station could take care of the Wailuku area. Eassie responded that it would not accommodate the entire area given the amount of development projected in the Wailuku area. They tried to create a timeline of wastewater demands, with the flow forecast increasing over time. Eassie added that when design flow meets 90 percent of capacity, the State requires that additional facilities need to be built according to chapter 62 by the Department of Health.

Berna asked how this information applies to CWG activities. Eassie responded that this information indicates the impacts of population growth on pump stations, and the timing and location of upgrades that would be needed and when. This will help in coming up with options such as satellite facilities, and placement.

John Karrow asked if the projected new development for 2030 were primarily residential. He also asked about industrial development that let out high BOP. He stated that some industries have potential to treat effluent. Eassie answered that the bulk of development would be residential, with some light industrial uses.

Glenn asked what would happen to the existing facilities that use septic tanks. Eassie stated that the plan should be expandable to take in cesspool areas, but that is not currently included. Dave added that those areas are relatively small compared to development areas.

Lambert Yamashita noted that, relative to tsunami impacts on the treatment facility, the project team includes a consultant who would evaluate the facility for vulnerability. Glenn felt that the project team should get a state expert. Dave stated that Ed Noda did an analysis that generated the level of a tsunami based on historical data to determine the forces and generated numbers. They reviewed blueprints and assessed the effects of a 100-year tsunami. Glenn opined that this company has made previous errors. Dave stated that once the project structural engineers do their study, they would have a better idea of where they are.

Lambert introduced Moffat and Nichol engineers who are addressing shoreline erosion issues. Russell Boudreau said that, currently, there are areas near the WWTF where the shoreline is eroding at a 4-5-ft/year rate. They will project how soon the shoreline may reach the plant. They will use UH and USGS studies that have been mapping shoreline changes to determine the long-term trend in shoreline erosion. Seasonal fluctuations and potential increased sea level rise will also be looked at, as well as natural or manmade practices that impact shoreline erosion.

Further, they will develop alternatives that may include curtailing erosion, artificially nourishment of the beach on a regional basis, or abandonment of the facility. They are going to get CWG input, rank the important evaluation criteria and develop associated costs (life cycle costs) to come up with the best approach.

Steve Holaday asked if cost estimates and a timeline for alternatives would be developed. Russell answered that they would have a cost analysis. Steve stated that if the estimate for building a new plant could be built for half of the cost of refurbishing the existing plant, it would be an easy decision.

Glenn stated that the five ft/year erosion was based upon UH data, and reviewing 49 photos and early 1900 T-sheets. There is no question that there is erosion occurring there. Russell stated that the erosion maps will be used to get an idea of the impact, and erosion looks to be dramatic.

Evaluation Criteria

Berna distributed a handout that summarized the options generated at the second meeting and noted that the options to carry out the four scenarios would need to be evaluated. She Steve stated that it is important to look at long term versus new plant costs, and that various alternatives must be combined and looked at in the CWG.

Berna discussed that options will be evaluated using a matrix as an initial working tool. The matrix would evaluate options against common criteria to see which options meet the highest number of criteria.

Grant Chun asked if the criteria were an expansion of guiding principles. Berna answered that they are trying to be more quantitative and specific about it by looking at the guiding principles and ranking the alternatives with a high, med., or low priority.

Participants were asked to initially list some criteria, and the following was developed:

- Capital Costs
- Operations and Maintenance Costs

- Risk Impact of Operating Failure
- Reliability
- Social impacts/ compatibility factors
- Environmental/ locational impact
- Location relative to existing infrastructure
- Location relative to end user
- Ability to expand
- Use of reclaimed water

Dave stated that everything washes out between up-front and end costs. In the alternative analysis, costs will be asked. It is easy to quantify, but we need to separate capital and long-term operation costs. Glenn asked him to define long-term. Dave responded that it includes ongoing annual costs, operations, and maintenance costs. Charles asked about environmental issues like odors, or wind patterns. Berna added that the visual impact relating to surrounding uses would be looked at with compatibility factors.

John asked how much space an 8-12 mg/day plant would require. He also asked if a map based on the purchase of water be made to see the high use of water for site consideration. Dave explained that it was better for a plant to be closer to where wastewater is processed because of the costs and risks associated with the transport of raw wastewater.

Dave suggested two matrices. One would be to evaluate the proposed improvements / expansion, and the other would deal specifically with how to dispose of the wastewater (recycling, etc.). He noted that all alternatives will have basically the same discharge options. Eassie added that regulation of nutrients in reclaimed water would be a concern.

Steve asked if, assuming that shoreline erosion or tsunami were not issues, the existing plant be expanded. Dave answered that, physically, the plant can be expanded. The extent of expansion would be an issue, however. He further noted that there is also an issue with the public use of the coast, and if the plant were expanded, shoreline recreational and other uses may be impacted.

Glenn stated that this information would eventually be given to the mayor, and he felt that it would be more advantageous to do this earlier.

Jason Koga asked how other disasters that develop swells and high surf, such as hurricanes, would impact the facility. Russell stated that this was something they would look at, because it is a seasonal short-term event that can take away the shoreline with wind damage or flooding. Dave stated that the effects of a tsunami would be stronger than hurricane waves. Glenn added that it would be advantageous for Russell to look at the report he previously provided Dave.

Next Step

Berna stated that she would distribute the meeting summary and a request for evaluation criteria ideas. This will help the team develop ranking and options. The next meeting will be on September 9 in the same location. ***Note the meeting was moved to September 16.***

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS ● SURVEYORS

Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 9/16/04

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 9/16/2004

The fourth meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group (CWG) was held on September 16, 2004 in the Maui County Civil Defense Conference Room. CWG participants included:

Thorn Abbott, (visitor) Maui County Planning Department

Kathleen Aoki, Maui County Planning Department, Long Range Planning

Grant Chun; A& B Properties

Lucienne deNaie, Sierra Club

Steve Holaday, Hawaiian Commercial and Sugar

Charlie Jencks, Maui Contractors Association

Martin Kirk, Hawaii Kiteboarding Association

Clyde Kono, Bank of Hawaii

Warren McCord, Maui Outdoor Circle

Jay Nakamura, Stanford Carr Developments

Zoe Norcross-Nu'u, Sea Grant Coastal Processes Extension Agent, Maui County

Dave Taylor, Maui County Dept. of Public Works

Glenn Shepherd, Maui Tomorrow

Project team participants included:

Tracy Takamine, Maui County Dept. of Public Works

Eric Nakagawa, Maui County Dept. of Public Works

Eassie Miller, Brown and Caldwell

Mike Miyamoto, Maui County Wastewater Reclamation Division, County of Maui

David Paul, Brown and Caldwell

Lambert Yamashita, Austin Tsutsumi and Associates

Daren Suzuki, Munekiyo & Hiraga, Inc.

Anne-Lise Lindquist, Moffatt and Nichol Engineers

Russell Boudreau, Moffatt and Nichol Engineers

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Meeting 3 Review

Berna Cabacungan reviewed highlights from the third meeting. She noted that the County had a meeting to discuss issues and options of the CMWWRF, and their conclusions mirrored those of the CWG.

Lambert Yamashita added that Dave Taylor was no longer the CMWWRF project manager, and is now a resource from the Office of the Managing Director. Mike Miyamoto is the current project director.

Status and Findings of Consultant Team

Russell Boudreau of Moffat and Nichol gave an update on the findings of the shoreline evaluation study.

His scope on this project is to study:

- Shoreline erosion quantification in terms of long and short term trends
- Assessment of potential causes of erosion
- Development of preliminary solution alternatives
- Concept development

Relevant coastal processes included:

- Littoral transport is the movement of sand by waves. Currently, the sand is influenced by the NE tradewind waves, which pushes the sand east to west, and also the North Pacific swell. He explained that the waves break at an angle and the current is wave driven.
- Wind moves and accelerates sand erosion.
- The coastal dune system holds sand on beaches. The coastal dune system provides natural shore protection and plays a critical role in both littoral and wind sand transport.
- Coral reefs act as a natural shoreline protection by breaking the waves before they reach the shore. Coral reefs also serve as an important sand source.
- Anthropogenic influences are those of man on environment. These include sand mining, historically used for sugar processing and concrete mixes in the 50's to 70's. There has also been dune destruction and reef destruction by man.

Site visit observations from July 16 at the Kahului Wastewater Reclamation Facility (WWRF) include evidence of past and recent erosion that included a World War II pillbox from the 1940s that is partially submerged. At the Wastewater Pump Station (WWPS), there is evidence of storm-induced erosion, altough it is not eroding rapidly. There are large amounts of debris and rubble on the beach and site does not appear to support public uses.

Long-term shoreline changes at the WWRF were determined by looking at data from:

- County of Maui shoreline erosion maps by UH and USGS
- Topographic sheets (T-sheets) and aerial photographs
- Erosion hazard rates

The erosion fronting the WWRF ranges from 1.0 to 2.5 ft/year, which is considered high. From 1929 to 1960 the area was fairly flat, and the beach was growing. From 1960 to 1975 they were seeing erosion rates up to a dramatic 16-ft/ year; some of which could be attributed to sand mining. From 1987 to 2002, the east side of the WWRF appeared to be building back up, but the west side had accelerated erosion. It appeared that with the revetment, there was a groin effect with sand collecting on the up drift side at rates of 2-6 ft/year.

Shoreline changes at the WWPS showed evidence of erosion but not to the extent of the WWRF. From 1912 to 1960, there was not much change at 1-2 ft/ year loss and from 1960 to 1987, erosion fluctuated at zero. From 1987 to 2002, there was some increase in beach up to four feet/year. Russ added that short-term fluctuations need to be considered with storm probabilities.

Shoreline protection alternatives were developed that included:

- No action
- Relocate some of the facility components to buy time

- Stabilize the shoreline through a) beach nourishment; b) shoreline protection using revetment or seawall; c) coral rubble berm.

Ranking criteria for alternatives would include examples such as:

- Construction Cost
- Maintenance Cost
- Public Access and Usage
- Design life
- Regulatory Compliance
- Environmental Impacts
- Impacts to Kahului Harbor
- Aesthetics

Grant Chun asked about the difference between a revetment and a seawall. Russ responded that a revetment is a slope of rock or concrete armor. The waves run off the slope. A seawall is a vertical wall, and the waves hit the wall hard and reflect back into the ocean.

Glenn Shepherd asked if in using of the topographic sheets, changes were made for magnetic North. Russ replied that they used the information from the USGS website and it was likely that necessary adjustments were made.

Glenn asked for rate of sea level rise. Russ responded that currently it is about 2.5-ft/ decade, which is not big compared to the shoreline erosion rates seen.

Glenn observed that there is more seasonal erosion occurring during the summer from wind and wave erosion.

Martin Kirk added that, behind the WWRF, there is a beautiful beach, but dangerous objects in the water. Russ stated that when cleaning up the beach, there would be cleaning up of the ocean as well.

Evaluation Matrix

Two handouts were distributed: draft Evaluation Matrix and the Evaluation Criteria Definitions. Berna explained that the matrix includes alternatives in the vertical axis and criteria in the horizontal axis. The criteria will be used to weigh alternatives against each other for ranking purposes. Both the criteria and alternatives were generated in discussions with the CWG.

Alternatives

Mike Miyamoto explained the Evaluation Matrix as a way to rate the alternatives, broken up into new capacity alternatives and demand side alternatives, by evaluation criteria, that included cost, environmental, reclamation, and disposal methods. On the horizontal axes, evaluation criteria is listed, and on the vertical axes, the options were listed. These criteria and options were products of CWG discussion.

Mike described each option in the following order:

1. No build/ Do nothing.

2. Expand and sustain existing Wailuku/ Kahului WWRF; strengthen plant for tsunami/ erosion.
3. Maintain existing Wailuku/ Kahului WWRF; construct satellite WWRF for additional capacity.
4. Maintain existing Wailuku/ Kahului WWRF; develop smaller individual wastewater systems.
5. Maintain existing Wailuku/ Kahului WWRF with deep ocean outfall.
6. Introduce Kanaha Pond for treatment process/ reclaimed water.
7. Build new WWRF for future flows and relocate existing WWRF.
8. New Central Maui WWRF to treat existing and future wastewater flows.

Warren McCord asked if the introduction of storm water into the wastewater system was being considered, or were current lines leaking. Mike responded that they were currently trying to fix existing lines that were leaking.

Steve Holaday stated that the no build or do nothing alternative did not seem like an option. Mike Miyamoto explained that it was always an option.

Warren McCord stated that he thought the Kanaha Pond alternative would be off limits. Thorn Abbott shared that he knew of many examples where wetlands were restored and reclaimed such as the Florida Everglades. Warren stated that it seemed that there would be a large amount of effluent. Steve agreed and stated that Kanaha Pond overflows now, and has to be controlled on a daily basis. Eassie stated that in the evaluation matrix, this alternative would probably rank low, but is included because it is still an option. Mike stated that perhaps the option of using Kanaha Pond as a filter or polishing aspect would be beneficial, not so much as a disposal. Glenn wondered what the salinity of Kanaha pond was, and if anyone had access to a salimeter.

It was noted that DOH has indicated that none of these options are off-limits from its perspective.

<u>*Disposal 101*</u>

Eassie presented the Central Maui wastewater service areas, clarifying his presentation at the third meeting. New additions included areas serviced by sewer systems. Eassie described methods of wastewater disposal, as follows:

- Deep ocean outfall

  This is a method of effluent disposal, whereby a pipe is buried and comes out onto the ocean floor. Diffusers discharge the effluent into the ocean. Impacts on marine life, such as in Marine Life Conservation Districts or the Humpback Whale Sanctuary, are issues.

- Groundwater recharge

  Another option is groundwater recharge. This method would involve taking treated effluent, apply it to a spreading basin, and allowing to percolate into brackish groundwater. Irrigation wells downstream could use the water for irrigation. Issues regarding this would be EPA permitting, and modeling to ensure that there would be no impact on potable water. It may also require substantial land area.

- Injection wells

  Effluent Injection wells are currently used. In this method, a pipe with treated effluent goes into the water table. Upland water mixes with the effluent and goes out into the ocean. Issues with this method would include DOH/UIC permits, and EPA permits.

Berna asked if water reclamation was an alternative. Eassie replied affirmatively and that where water reclamation is used, they are required to have a backup disposal system, and water quality is regulated.

Glenn stated that oil companies use radioactive tracers to trace flows. Dave Taylor added that these were used in drilling wells in West Maui. Eassie added that they were doing this to see where the effluent was going into the ocean. Glenn noted that they found one sampling, but there should be more.

<u>Criteria Definitions</u>

Berna asked the group to review the criteria definitions.

Steve Holaday asked if there are any federal funds available for alternatives. Dave stated that he was looking for funds available, and that this was unanswerable at this time. Eassie stated that there might be a low interest loan the County could use.

Warren asked about the minimum noise impact definition and if the system would make much noise. Eassie answered that there was potential for noise, and including noise from equipment and truck traffic.

Berna stated that each criteria needs to be able to discern alternatives and this came out of the CWG and project team as a way to weigh alternatives.

NEXT STEP

<u>Pairwise Comparison</u>

David Paul presented the Pairwise Comparison and a matrix was distributed. David explained that pairwise comparison was a quantitative way of evaluation where one criteria can be compared to another. This would allow the group to rank alternatives based on the criteria.

A tool, pairwise comparison uses a spreadsheet to register scores, and calculates the ranking of alternatives. When comparing A to B, the highest score would be a “5” if A is much more important than B, down to a “1” if A is much less important than B. The “3’s” currently on the spreadsheet are default numbers and will change once a number is inputted.

Berna stressed that the balanced nature of the group is key and when they obtain everyone’s results, scores would be tallied for a cumulative score. David stressed that it is important to do this independently.

Jay Nakamura requested that, because this was such an important part in the project, the group should not proceed until the majority of the group completes the homework.

The homework is due October 4, 2002. The next meeting will be on November 18, 2004 at 4:00.

Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 11/18/04

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 11/18/2004

The fifth meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group (CWG) was held on November 18, 2004 in the Maui County Civil Defense Conference Room. CWG participants included:

Kathleen Aoki, Maui County Planning Department, Long Range Planning

Grant Chun A& B Properties

Charlie Jencks, Maui Contractors Association

Martin Kirk, Hawaii Kiteboarding Association

Warren McCord, Maui Outdoor Circle

Jay Nakamura, Stanford Carr Developments

Leiane Paci, Maui Lani

Ed Reinhardt, Maui Electric Company

Dave Taylor, Maui County Office of the Managing Director

Project team participants included:

Tracy Takamine, Maui County Wastewater Reclamation Division

Mike Miyamoto, Maui County Wastewater Reclamation Division

Eric Nakagawa, Maui County Wastewater Reclamation Division

Lambert Yamashita, Austin Tsutsumi and Associates

Eassie Miller, Brown and Caldwell

Daren Suzuki, Munekiyo & Hiraga, Inc.

Russell Boudreau, Moffatt and Nichol Engineers

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Meeting 4 Review and Handouts

Berna Cabacungan reviewed highlights from the fourth meeting. She reviewed highlights from the presentation by Russell Boudreau. The homework related to the Pairwise Comparison matrix was also discussed, and it was noted that nine people from the CWG turned in the homework. Handouts distributed at this meeting included:

- Central Maui Waste Water Reclamation Facility Study: Evaluation Matrix (draft)
- Central Maui Waste Water Reclamation Facility Study Alternative Descriptions
- Results of Pairwise Comparison Homework Combined Results of CWG and County
- Shoreline Evaluation Study Ranking Criteria

Status and Findings of Consultant Team

Russell Boudreau of Moffat and Nichol gave an update on the alternatives analysis and preliminary ranking criteria. He presented information on the alternatives analysis for the Wailuku / Kahului WWTP as follows:

- Revetment

  The revetment would be similar to the existing revetment that is 450 feet in length, and would extend 1200 feet. It would extend and fix the west flank area.

- Beach nourishment

  Beach nourishment would involve constructing a 600-foot wide beach that is over 4,000 linear feet, requiring 300,000 cubic yards of sand for the initial fill. The beach would have to be re-nourished every 10 years with 210,000 cubic feet of sand. Sand sources would include inland quarries, or off shore sources.

  Martin Kirk asked how much sand would fill a dump truck. Russell responded that about 15 cubic feet fit into a dump truck. The amount of sand was determined at a volume that would not have to be replaced every year, using the average erosion rate, and adjustment for a buffer. Martin asked if this was in lieu to the revetment. Russell responded that it was, but both could be done.

  Tracy Takamine asked why the beach was so long. Russell responded that the beach has to be long because of the net transport of the sand being more stable if it is spread. Also, with a smaller volume of sand, there would have to be more maintenance, which has high cost. Russell added that he would include considerations of smaller initial fills in the alternative analysis.

  Jay Nakamura asked if offshore material were free or State-owned. Russell stated that the material is typically free, but there is cost to dredge and place the material on the beach. Ed Reinhardt asked if there were environmental issues. Russell responded that there are many environmental issues that must be considered such as hard-bottom habitat loss, sea turtle disruption, construction noise and pollution. Ed asked if there was a lot of coral offshore. Russell answered that he had not personally observed the offshore area but would look into it..

- Nourishment with retention structures

  The beach nourishment with retention structures would involve a 50-foot wide beach, with structures that hold the beach in place such as T-groins, resulting in less re-nourishment. There would be a greater up front capital cost but less cost for re-nourishment.

- Coral rubble

  Coral rubble revetment uses natural littoral material. Coral rubble will gradually break up into beach sand.

Order of magnitude costs for the first three alternatives are as follows:

- Beach nourishment: $471,000/ year
- Beach nourishment with groin: $89,000/ year
- Revetment: $4,500/year

Russell then presented the alternatives analysis for the Wailuku Pump Station, which included engineered revetment and rubble improvement. Beach nourishment and a seawall were not considered.

Russell presented the following as possible criteria for ranking the criteria for alternatives would include examples such as:

- Construction Cost
- Maintenance Cost
- Public Access and Usage
- Design life
- Regulatory Compliance
- Environmental Impacts
- Impacts to Kahului Harbor
- Aesthetics

Charlie Jencks asked if the rankings were correlated to rate increases. Russell responded that the cost estimates are in terms of life cycle costs. Charlie asked if this would change with the cost to the ratepayer. Russell responded that this was probably for the County to analyze and that external funding sources can also be considered.

Kathleen Aoki stated that she heard that the State Department of Health (DOH) stopped allowing beach nourishment six months ago due to environmental issues. Russell replied that there are strict chemical and biological guidelines for the quality of beach material, and has not heard that the DOH prohibits beach nourishment.

Grant Chun asked if the impact on adjacent shoreline areas was assessed. Russell responded that there would probably be not much impact since there was historically a wider sandy beach at this location. The sand may gradually collect in Kahului Harbor and discontinuous shoreline maintenance would have a detrimental impact. The revetment would be the last line of defense if the sand on the beach were not maintained.

Ed Reinhardt commented that the North Shore of Maui is unlike Florida, an example previously cited. There is a lot of wave action and he does not know if beach nourishment will work; the wave action may cause erosion. Russell stated that this was taken into consideration and noted that there are reefs offshore that help to control wave action.

Lambert Yamashita discussed other consultant studies. Nagamine and Ko Associates is conducting a structural evaluation of the existing facility in regards to conditions related to a100-year tsunami. With recent upgrades taken into account, it was found that five structures do not comply with 100-year tsunami standards.

The overall structures are sound and other issues and forthcoming costs will be incorporated with the shoreline management plan, and will be handled as a package. The financial component will include alternatives, and will give a broad sense of funding methods for the project, and look at other funding sources that may exist. These cost issues will be presented at the next meeting.

Evaluation Criteria

Berna Cabacungan gave an overview of the Pairwise homework results. She stated that nine members of the CWG and six members from the County completed the homework. She further noted that there were strong similarities County and CWG responses; the top five criteria were the same for both groups.

Alternative Evaluation Matrix

Eassie Miller presented a draft evaluation matrix that evaluates each alternative, based on criteria that were weighted in the homework. Values of one, three, and five were used to make options more distinguishable. One was the most negative and five is the most positive. He then reviewed the information on the alternatives based on the handout.

Tracy Takamine asked if Alternatives #1 and #8 were the same. Eassie answered that the difference between #1 and #8 was in the disposal methods, i.e. injection wells versus deep ocean outfall. Tracy asked if they could hold the disposal methods for later discussion. Eassie noted that the disposal methods can have significant permitting implications, and are part of the criteria. .

Warren McCord was curious about the permitting process that would allow effluent to be put into Kanaha Pond. He felt that it would be longer than his life span for this to be done, and couldn't imagine effluent ever going into the pond. Berna stated that now was the time to refine the alternatives that they came up with in the workshop.

Dave Taylor suggested an alternate approach to evaluating the alternatives. He recommended that each alternative have four sub-alternatives based on disposal methods. These sub-alternatives are:

- Deep ocean outfall
- Groundwater recharge
- Injection wells
- Wastewater reclamation

Given this approach, there would be six alternatives, each of which the first five would have the same disposal methods:

1. Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns
2. Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Construct satellite WWRFs for future capacity
3. Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Develop smaller individual wastewater systems for future capacity
4. Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku / Kahului WWRF
5. Build new WWRF for future flows and relocated existing Wailuku / Kahului WWRF away from tsunami and erosion zone
6. No build / Do nothing

Dave stated that the no-build option should be taken off the rankings because even though there is still remaining capacity, improvements would still be needed. Ed agreed that the no-build is not an option in the future and that something has to be done. Eassie stated that if the County chooses the no-build option, then it would be upon the developers to have their own treatment and disposal systems. It was decided that the no build option would remain as an alternative for planning purposes.

Warren stated that recycling water is important. They can find users, there will be high volume, and they may end up with a fifth alternative with a combination.

Dave noted that the next step would be to look at the preliminary engineering report, so they know what part of the existing plant could remain and operate and then other processes can be added.

Next Step

The project team will modify the evaluation matrix based on changes decided at this meeting. CWG members will be asked to provide their opinions on the alternatives.

The next meeting is scheduled for ***February 3.*** Please note that this is a revised date.

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Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 2/3/05

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 2/03/2005

The sixth meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group (CWG) was held on February 3, 2005 in the Maui County Civil Defense Conference Room. CWG participants included:

Kathleen Aoki, Maui County Planning Department, Long Range Planning

Grant Chun, A&B Properties

Steve Holaday, Hawaiian Commercial and Sugar

Martin Kirk, Hawaii Kiteboarding Association

Zoe Norcross, Sea Grant Coastal Processes Extension Agent, Maui County

Warren McCord, Maui Outdoor Circle

Ed Reinhardt, Maui Electric Company

Glenn Shepherd, Maui Tomorrow

Dave Taylor, Maui County Office of the Managing Director

Project team participants included:

Tracy Takamine, Maui County Wastewater Reclamation Division

Eric Nakagawa, Maui County Wastewater Reclamation Division

Lambert Yamashita, Austin Tsutsumi and Associates, Inc.

Eassie Miller, Brown and Caldwell

Kieu Oahn Nguyen, Western Financial Group

Daren Suzuki, Munekiyo & Hiraga, Inc.

Russell Boudreau, Moffatt and Nichol Engineers

Berna Cabacungan, Earthplan

Sara Verga, Earthplan

Meeting 5 Review

Lambert Yamashita introduced Eric Nakagawa as the new project director.

Berna Cabacungan reviewed highlights from the fifth meeting. She outlined the presentation by Russell Boudreau on available alternatives for the current facility regarding beach re-nourishment and retention structures. Berna also summarized the presentation by Eassie Miller on the preliminary alternatives evaluation matrix. The most notable changes to the evaluation matrix alternatives were the addition of disposal options to each major alternative.

Status and Findings of Consultant Team

Russell Boudreau of Moffat and Nichol gave an update on the alternatives analysis to address shoreline erosion and on the ranking criteria related to evaluating options. He presented the alternatives and possible solutions for the Wailuku/ Kahului WWTP as follows:

Alternatives 1a and 1b: Beach nourishment

> Alternative 1a: Beach Nourishment would involve constructing a beach that is over 4,000 linear feet.
>
> Alternative 1b: This is similar to alternative 1a, but reduced in length. A possible drawback of a shorter beach is that it may erode more quickly.

For both alternatives, the beach would have to be re-nourished every ten years with 210,000 cubic feet of sand, assuming a 2.4 ft/year rate of erosion. A fifty-foot wide buffer would be necessary to protect the facility, if relying solely on beach nourishment. Sand sources would include inland quarries or offshore sources.

Alternative 2: Nourishment with retention structures

Beach nourishment with retention structures would involve a 50-foot wide beach with structures, such as T-groins, that hold the beach in place; this would require less re-nourishment. The T-groins also stabilize the beach and is more effective with sand moving in different directions. There would be a greater up front capital cost but less cost for re-nourishment.

Alternative 3a and 3b: Extend existing revetment

Alternative 3a: Combine a buried revetment with a beach nourishment project. This would work as a last line of defense, and would extend to the east flank and west end of the project site.

Alternative 3b: Use the existing revetment, and add beach nourishment, keeping at least a 30-foot wide beach.

Alternative 4: Coral Rubble Revetment

Coral is natural rubble and can be effective because it is stable.

Warren McCord asked about the sand source for beach nourishment. Russell replied that inland sand sources cost approximately $25/ yd and there is insufficient data in Hawaii for alternative sand sources. Considering these cost impacts, it is not feasible. However, other coastal states dredge sand from offshore sources and pump it onshore. There is limited experience with this in Hawaii, but could be an option. There is currently a pilot project in Waikiki at a smaller scale, and more research needs to be done.

Russell then presented the alternative analysis for the Wailuku Pump Station, which included engineered revetment and rubble improvement. Beach nourishment and a seawall were not considered because the main concern was protecting the erodeable surface above the mostly rubble beach.

Russell presented the ranking criteria using the Pairwise comparison method. The most important criteria resulting from this was the environmental implications. i.e. impacts on the biological and shoreline ecosystem. The alternatives were ranked as follows:

1. Buried Revetment
2. Extend existing revetment
3. Beach Nourishment
4. Beach Nourishment

Glenn Shepherd asked if Russell based his research on winter or summer conditions. Russell replied that he used statistical data collected over many years, which included variations of summer and winter sand levels. He added that there was generally a 30- to 50-foot seasonal fluctuation, and that he used the best available data. Glenn suggested that Russell use the 1972 UH profiles of the beach area that goes along the sand channels. He asked for the direction of the littoral drift. Russell replied that it generally moved east to west to the harbor.

Zoe Norcross asked what happens to the sand at the end of the channel. Russell replied that it might move to the entrance of the harbor. While some sand moves to that area, most of it does not remain in the system. Zoe stated that if erosion rate is 2 ft/yr, the sand is going somewhere. Glenn pointed out that the sand channels in the area probably collect the eroding beach sand and suggested that they get a diver to measure it.

Warren McCord asked if this presentation implied that the existing facility would be maintained. Russell explained that this was a study of options if the existing plant were the preferred alternative.

Warren asked if there is an analysis of the future of Kahului Harbor. He has heard that there are plans to modify and expand the harbor and asked how this would impact the WWRF. Russell responded that further study is needed to determine the impacts of beach nourishment on the harbor.

Glenn added that he believes most of the sand is going into the sand channels. Russell stated that more data is needed to prove this. Glenn asked if there were any surveys of the harbor or harbor mouth. Russell stated that there are only pre-dredging and post-dredging surveys. Glenn asked if the channel could be choked off by sand. Russell stated that the sand from the dredging surveys was too fine and unlike the beach sand from the WWRF. Grant Chun asked if he could see the slide on sand channels that Glenn and Russell were discussing.

Zoe felt that if they were to dredge the sand in the channel, there would need to be a sand field, or a more extensive area of sand. Russell answered that the sand would be brought in and would not originate from the littoral area. They would need to explore offshore options.

Glenn stated that the County should not maintain the plant in the tsunami zone. Berna responded that the shoreline study is being conducted to explore the effects of shoreline erosion *if* it stays in the current location. Russell added that the current facility is designed for a 100-year tsunami.

Lambert Yamashita presented the status of the structural study on the current facility. He stated that the most recent study by the structural engineering consulting firm, Nagamine and Okawa, evaluated the older sections of the existing facility. The buildings that were evaluated to withstand tsunami impact included:

- Headworks building, consisting of a steel frame Butler building
- Secondary Clarifier, Aeration Basin and Aerobic Digester tanks
- Effluent Meter Box, Filter and Chlorine Contact tanks
- Operations Building with Elevated Centrifuge Platform

The evaluation found that the overall structures are sound, but identified the following concerns:

- Buoyant forces are a concern with several of the concrete tanks. A solution is to fill the tanks with enough water to offset the buoyant forces, if a tsunami should occur.

- Scouring impacts upon the foundation is also a concern. A solution is to deepen the foundations by 3.5 feet. The project team is currently developing cost estimates.
- The operations building and headworks building stability are concerns. A tsunami would probably destroy the structure, but the process components would still be operational. A solution could be to fortify the areas with concrete.

Other issues and forthcoming costs will be incorporated with the shoreline management plan and will be handled as a package. The financial component will include alternatives, and will give a broad sense of funding methods for the project and look at other funding sources that may exist.

Zoe stated that she had seen photos after the tsunami in Indonesia. In one instance, she observed a photo of a revetment and post-tsunami photos of its destruction. She asked if this could happen at this facility. Lambert stated the scouring movement of debris undermines many structures. He added that the concrete structures could withstand the movement of water and remain in place. Zoe noted that the revetment appears to have depth. Russell stated that he has heard numerous accounts of seawalls and revetments that held and protected during that tsunami.

Glenn stated that although the facility may be structurally protected, the plant would become dysfunctional if it were inundated with salt water.

Tracy Takamine discussed the estimates on down time with such an occurrence. Some facilities have submarine doors, and they could be locked down to protect the facility. He also suggested that might be feasible to have pumps and motors stored at another facility to have spare parts on hand.

Warren asked if the facility would be impaired if untreated effluent were pumped into the injection wells. Tracy responded that there would be a clogging of the wells if untreated effluent were discharged into the wells. Eric added that emergency generators would provide electricity to the pumps. Steve Holaday asked if the pumps and motors are sufficient. Eric responded that they are about 300 horsepower and would be more than sufficient.

Dave stated that the issue of having the facility in working order could be as minor as having spare parts and being able to replace them quickly to restore operations in a facility that is designed to withstand a 100-year tsunami.

Berna introduced Kieu Oahn Nguyen from Western Financial Group. Kieu Oahn explained that she is preparing a study that evaluates and summarizes alternative financing methods; it includes a summary of current County financing mechanisms. Her report will be complete in early March. It will include an inventory of public financing mechanisms and options to finance proposed improvements.

Steve stated that it was easy to finance the project but it is not as easy to pay for it. Kieu Oahn replied that part of her task is looking at the impacts on user rates and look at the different options available to find the most effective and efficient package. Steve noted that those with a personal home septic system would likely not want to pay for the rest of the system.

Alternatives Evaluation System

Berna presented an overview of the process that led to the development of an evaluation of the various alternatives. She reviewed the timeline that was presented in March 2004, and explained that the CWG developed four scenarios. These scenarios helped participants explore a full range of alternatives and the alternatives were finalized by the CWG.

The CWG then developed criteria that reflected community values. More importantly, the CWG weighed the criteria using the Pairwise Comparison approach. This weighing process determined which values have more weight in evaluating the alternatives.

The various criteria, which reflected community values, were grouped into four categories. Eassie Miller presented the percentages of the criteria groups based on 100 percent.

Environment: 47%
Cost 25%
Recycling: 10%
Other: 18%
Total: 100%

Using the weighted criteria, the County Wastewater Reclamation Division ranked the alternatives developed with the CWG. He distributed an Alternatives Summary handout that listed the alternatives by rank.

Glenn asked if the demand side alternatives would be defined. Eassie replied that these alternatives cannot achieve the wastewater capacity demands needed and are viewed as complementary to the new capacity alternatives.

Eassie stated that the project team will develop information packages for the top alternatives. The packages will include order of magnitude costs, and factors related to permitting, siting, effluent disposal, and community issues.

Glenn asked who would make the decision on the alternative. Eassie explained that the Maui County Council will approve of the funding.

Warren asked why the alternatives related to satellite treatment plants were ranked lower than other alternatives. Eassie replied that it is possibly tied to cost issues. The ranking also includes operational costs and environmental factors.

Dave added that the Department of Public Works will recommend an alternative to the mayor, who then will make a recommendation to the County Council.

Martin Kirk asked if they were to construct a new WWTP, would it be on the existing site or elsewhere. He further asked if there is a major difference if eight out of ten alternatives involve relocation. Eassie responded that each alternative would be looked at separately.

Dave stated that the evaluation matrix did not show cost differences, and that this may be why relocation alternatives are rated higher. He added that, if costs were assigned to each alternative, there would likely be a difference in ranking.

Warren noted that building small facilities seemed to be related to the cost of distributing reclaimed water and he was surprised that it scored so low. Eric responded that the ranking was totally unbiased, and this was a cost issue.

Glenn asked if GIS procedures were used to locate a new facility. Tracy responded that this study represents a conceptual process, and that specific siting methodology would be addressed as information becomes more detailed.

Steve asked if implementation time frames were considered in the criteria. Eassie responded that implementation of any alternative would require five to seven years. Dave added that this was why the project was being done now to ensure sufficient time for permitting, construction and other timing issues.

Warren asked how different the draft report would be from the information that had already received. Berna responded that the draft report would consist of the alternatives and cost analysis with the order of magnitude costs.

Glenn asked if the existing sewer pipes at the WWTP would be abandoned. Dave responded that the pipes could be flushed with water, and filled with concrete. Tracy suggested that another option could be to leave the facility intact and use it as a pump station. Eassie added that another option could be to use the plant for aquaculture, similar to another project done by UH.

Warren asked how much intrusion water came into the facility. Tracy replied that there were two types of intrusion water, rainwater and groundwater, and there is more rainwater than groundwater. Eassie stated that they are trying to eliminate some of the intrusion water in a current project through the repair and replacement of lines.

Next step

A draft report will be mailed out consisting of the order of magnitude costs for each of the alternatives at the end of March. The next CWG meeting will be on April 7th to discuss the draft report, which will then be presented to counsel by the project team in June.

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Central Maui Wastewater Reclamation Facility Project
Core Working Group
Meeting Summary of 4/7/05

Central Maui Wastewater Reclamation Facility Project

Core Working Group

Meeting Summary of 4/07/2005

The seventh and last meeting of the Central Maui Wastewater Reclamation Facility Project Core-Working Group was held on April 7, 2005 in the Maui County Civil Defense Conference Room. The following lists Core Working Group members who were present at the meeting:

Grant Chun, A&B Properties
Steve Holaday, Hawaiian Commercial and Sugar
Charlie Jencks, Maui Contractors Association
Clyde Kono, Bank of Hawaii
Jay Nakamura, Stanford Carr & Associates
Zoe Norcross, Sea Grant Coastal Processes Extension Agent, Maui County \
Leiane Paci, Maui Lani
Glenn Shepherd, Maui Tomorrow
Dave Taylor, Maui County Office of the Managing Director

Project team participants included:

Tracy Takamine, Maui County Wastewater Reclamation Division
Eric Nakagawa, Maui County Wastewater Reclamation Division
Lambert Yamashita, Austin Tsutsumi and Associates, Inc.
Eassie Miller, Brown and Caldwell
Daren Suzuki, Munekiyo & Hiraga, Inc.
Berna Cabacungan, Earthplan
Sara Verga, Earthplan

Summary of Meeting 6

Berna Cabacungan opened the meeting thanking the members for attending, and reviewed highlights of the previous meeting. She discussed findings presented by Russ Boudreau of Moffatt and Nichol on the shoreline evaluation study. Based on the Pairwise Comparison method, the ranking order of shoreline alternatives was as follows:

1. Buried revetment
2. Extending the existing seawall / revetment
3. Beach nourishment
4. Beach nourishment with retention structures

She also reviewed findings of the structural evaluation of the existing Kahului Wastewater Reclamation Treatment Facility, and noted that Kien Quan of Western Financial Group presented her scope of work, which included identifying financial options for Maui County.

Berna also summarized the results of the evaluation matrix, which included 21 alternatives and criteria developed by the Core Working Group. She added that the top ten ranked alternatives would be discussed at this meeting.

Presentation of Draft Report

Lambert reported that, although the draft report was tentatively scheduled for release at the end of March, with this meeting to be held for open discussion of the report, the report was not released as planned. While the draft report was 95 percent complete, the consultant team wanted to make sure it was cohesive and completely accurate before issuing a draft. He then presented the report outline.

A fundamental section of the report is the alternatives, and Eassie Miller presented the top ten ranked alternatives that would be further described in the report and presented to the Department of Public Works and Maui County Council. He noted that the basic alternatives included: 1) expand the existing facility and continue to build at the current location, 2) develop a new regional facility, and 3) build two new facilities and phase out the existing facility. The ten alternatives included variations of these core alternatives. Each basic alternative was evaluated in terms of criteria developed by the Core Working Group, and these were related to environmental concerns disposal options, including water recycling opportunities, site options, community impacts, permit requirements, cost impacts, and service area.

Highlights of the ten alternatives are as follows. Note that the number of "$" symbols under Cost Impact denotes cost magnitude relative to other alternatives.

Alternative 1

Alternative Description	• Expand existing Wailuku/Kahului WWRF to treat future flows • Fortify WWRF to withstand 100 year tsunami • Reinforce shoreline to mitigate shoreline erosion • Effluent quality - R-2 effluent • Effluent disposal - Injection wells • WWRF requires effluent filters
Water Recycling Opportunities	• Onsite irrigation • Kanaha Park R-2 irrigation
Site Options	• Existing WWRF site
Community Impacts	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami
Permit Requirements	• CDUA • SMA • UIC permit • Shoreline Variance (Shoreline armoring) • Environmental Assessment or Environmental Impact Statement
Cost Impacts (relative to other alternatives)	• Capital - $ • O&M - $ • Sunk -
Service Area	• Central Maui Region

Alternative 2

Alternative Description	• Construct Regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF site • Effluent quality – R-1 effluent • Effluent disposal – Brackish groundwater recharge • Requires redundant disposal • Requires major wastewater collection system upgrade
Water Recycling Opportunities	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal
Site Options	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges
Permit Requirements	• EIS • UIC permit (Potential) • Rezoning • Community Plan revision • Large land area requirement for groundwater recharge
Cost Impacts	• Capital - $$$$ • O&M - $$ • Sunk - <$>
Service Area	• Central Maui Region • Maalaea • North Kihei

Alternative 3

Alternative Description	• Construct Regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-1 effluent • Effluent disposal – Water Recycling • Requires redundant disposal • Requires major wastewater collection system upgrade
Water Recycling Opportunities	• Onsite WWRF irrigation • Agriculture irrigation • Industrial reuse • Open space irrigation • Golf course irrigation
Site Options	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact – major capital expenditure • Increased potential for odor discharges
Permit Requirements	• EIS • UIC permit • Rezoning • Community Plan revision
Cost Impacts	• Capital - $$$$$ • O&M - $$$ • Sunk - <$>
Service Area	• Central Maui Region • Maalaea • North Kihei

Alternative 4

Alternative Description	• Construct Regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-2 effluent • Effluent disposal – Injection wells • Requires WWRF effluent filters
Water Recycling Opportunities	• Groundwater recharge • Onsite WWRF irrigation • Open space irrigation from groundwater withdrawal
Site Options	• Old Puunene Airport • Adjacent to Puunene Sugar Mill • South of Kuihelani Highway • South of Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact caused by major capital expenditure • Increased potential for odor discharges
Permit Requirements	• EIS • UIC permit • Rezoning • Community Plan revision
Cost Impacts	• Capital - $$$ • O&M - $$ • Sunk - <$>
Service Area	• Central Maui Region • Maalaea • North Kihei

Alternative 5

Alternative Description	• Construct new Central Maui WWRF for future wastewater flows • Relocate Wailuku/Kahului WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-1 effluent • Effluent disposal – Brackish groundwater recharge • Redundant effluent disposal required • Requires major wastewater collection system upgrade
Water Recycling Opportunities	• Groundwater recharge • Onsite WWRF irrigation
Site Options	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure • Requires large land area
Permit Requirements	• EIS • UIC Permit (Potential) • Rezoning • Community Plan Revision
Cost Impacts	• Capital - $$$$$ • O&M - $$$ • Sunk - <$>
Service Area	• Central Maui • North Kihei • Maalaea

Alternative 6

Alternative Description	• Construct new Central Maui WWRF for future wastewater flows • Relocate Wailuku/Kahului WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-1 effluent • Effluent disposal – Water Recycling • Redundant effluent disposal required • Requires major wastewater collection system upgrade
Water Recycling Opportunities	• Groundwater recharge • Agriculture irrigation • Open space irrigation • Onsite WWRF irrigation • Golf course irrigation
Site Options	• South of Airport • South of Kuihelani Highway • Keopulani Regional Park • Adjacent to Puunene Sugar Mill • Old Puunene Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure
Permit Requirements	• `EIS • UIC Permit (Potential) • Rezoning • Community Plan Revision
Cost Impacts	• Capital - $$$$$$ • O&M - $$$ • Sunk - <$>
Service Area	• Central Maui • North Kihei • Maalaea

Alternative 7

Alternative Description	• Expand existing Wailuku/Kahului WWRF to treat future flows • Fortify WWRF to withstand 100 year tsunami • Reinforce shoreline to mitigate shoreline erosion • Effluent quality - R-1 effluent • Effluent disposal – Brackish groundwater recharge • Redundant effluent disposal required • Large land area required for groundwater recharge
Water Recycling Opportunities	• Onsite irrigation • Groundwater recharge • Open space irrigation from groundwater withdrawal
Site Options	• Existing WWRF site • South of Kuihelani highway for groundwater recharge
Community Impacts	• Potential for shoreline degradation • Potential for catastrophic system failure caused by tsunami
Permit Requirements	• CDUA • SMA • UIC permit • Shoreline Variance (Shoreline armoring) • Environmental Assessment or Environmental Impact Statement
Cost Impacts	• Capital - $$ • O&M - $$ • Sunk - <$>
Service Area	• Central Maui Region

Alternative 8

Alternative Description	• Construct new regional Central Maui WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-2 effluent • Effluent disposal – Ocean outfall
Water Recycling Opportunities	• Onsite WWRF irrigation
Site Options	• Adjacent to Puunene Sugar Mill • South of Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure
Permit Requirements	• Environmental Impact Statement • UIC permit • Rezoning • Community Plan revision
Cost Impacts	• Capital - $$$$$$$ • O&M - $$ • Sunk - <$>
Service Area	• Central Maui Region

Alternative 9

Alternative Description	• Expand existing Wailuku/Kahului WWRF to treat future flows • Fortify WWRF to withstand 100 year tsunami • Reinforce shoreline to mitigate shoreline erosion • Effluent quality – R-2 effluent • Effluent disposal – Ocean outfall
Water Recycling Opportunities	• Onsite irrigation
Site Options	• Existing WWRF site
Community Impacts	• Potential for shoreline degradation • Potential for catastrophic system failure from tsunami
Permit Requirements	• CDUA • SMA • UIC permit • Shoreline Variance (Shoreline armoring) • Environmental Assessment or EIS
Cost Impacts	• Capital - $$$$ • O&M - $$ • Sunk -
Service Area	• Central Maui Region

Alternative 10

Alternative Description	• Construct new Central Maui WWRF for future wastewater flows • Relocate Wailuku/Kahului WWRF • Phase out existing Wailuku/Kahului WWRF • Construct tsunami proof WWPS at existing WWRF • Effluent quality – R-2 effluent • Effluent disposal – Injection wells • WWRF requires effluent filters
Water Recycling Opportunities	• Groundwater recharge • Onsite WWRF irrigation
Site Options	• South of Airport • South of Kuihelani Highway • Adjacent to Puunene Sugar Mill • Old Puunene Airport
Community Impacts	• Extension of Kanaha Beach Park • Reduced potential for catastrophic system failure • Financial impact - major capital expenditure
Permit Requirements	• EIS • UIC Permit • Rezoning • Community Plan Revision
Cost Impacts	• Capital - $$$$ • O&M - $$$ • `Sunk - <$>
Service Area	• Central Maui • North Kihei • Maalaea

Glenn Shepherd asked if R-2 effluent could be used for irrigation such as sugar. Steve Holaday responded that it would be a challenge to use the R-2 water for irrigation for crops of direct consumption. More information on environmental regulations and agricultural use is needed to determine possible use.

Zoe Norcross asked for clarification that the environmental criteria were the Core Working Group's primary area of criteria. Eassie responded that of the total criteria, 45 percent were related to the environment. Dave Taylor added that, even though an alternative may be good for the environment, it could still rank low when weighed against other criteria such as costs and operations.

Eassie presented potential capital costs of the three core alternatives and stressed that these are very preliminary. He noted that land and facility variables could push estimates out of either end of the range.

Jay Nakamura asked how many households would be serviced. Dave responded that all of Central Maui would be serviced, and Eassie added that around 10 MGD could be treated.

Charlie Jencks asked if cost estimates for Alternative 1 included transporting R-1 effluent to parks for irrigation. Eassie responded that it was not the intent of Alternative 1, but would be possible in addition to efforts for groundwater recharge. He added that the Mayor was looking at domestic water source development, which would have a direct effect with recharge. If that happened, recharge would not be a viable option.

Dave asked why alternatives that included water reclamation did not make the top ten alternatives. Berna explained that the County's evaluation resulted in this overall ranking. All participants agreed that an alternative with water reclamation should be part of the top ten alternatives, and Eric Nakagawa said that he would make sure this would occur.

Glenn asked how much R-1 water Steve Holaday could use. Steve responded that he needed more information but it is likely that they could use this water. He noted that R-2 cannot be used for irrigating any agricultural product that may be directly consumed, such as corn or wheat. He also noted that there are problems with nutrient loading.

Dave asked if reinforcing the shoreline would require an environmental assessment, or EA, or Environmental Impact Statement, or EIS. Darren Suzuki responded that it would trigger an EA or EIS depending on the level of impact significance.

Charlie Jencks asked how the improvement costs would be divided among 20,000 sewer hookups. Eassie responded that it could be funded by the County General Fund and sewer user fees, and noted that further information and options would be available in the financial section of the project report.

Eassie suggested that there were other technologies being looked at, such as a scalping wastewater facility, where the water is recycled and used for irrigation in areas that exhibit demand is. He added that this is a challenge for Maui because, currently, treating the water in one area and pumping it to another is expensive. Scalping facilities are modular and expandable and are currently being used in Los Angeles where inner city reclamation facilities recharge groundwater by disposing solids back in to the sewer to go to the treatment facility.

Glenn asked how many facilities would be possible. Eassie replied that this area could have one to three such facilities. Charlie asked if there were an optimal number of units. Eassie replied that it could treat 3 to 4 MGD. Glenn asked how much area it takes. Eassie replied that it was small, and takes about 60 to 100 square feet. Glenn asked if it figured into the matrix. Eassie replied that it can be in range of the regional facilities, or two wastewater facilities. There are lots of options and spin-offs that can come out of this technology.

Review of Core Working Group Accomplishments

Berna complimented the Core Working Group in terms of its contributions to the overall project. The accomplishments have directed and guided the recommendations of the consultant and County project team. Core Working Group accomplishments included

- Guiding principles that reflect community values and guided the project team in developing and evaluating alternatives
- Four planning scenarios that helped the project team develop and expand project alternatives

- The identification of and weighting of evaluation criteria that provided the evaluation parameters and framework for the alternatives evaluation matrix

Future Steps

Steve asked if any preliminary work is being done related to federal or state money available to pay for the capital. He was concerned that, with 18,000 to 20,000 sewer hookups, any alternative would require a massive amount of money. Lambert responded that they were still waiting for more cost estimates. Steve suggested that in the public meetings, it is important to have cost estimates / ranges for the general public.

Eassie noted that there is no federal money. There may be State funds that provides loans on lower interest rates, but these would be on a first-come, first-served basis. Also, Maui would need to compete with other jurisdictions.

Steve was concerned that there may be no completely fair way in allocating costs; some individuals who have already purchased homes may have already paid for sewer development as part of their home purchase and they would not want to pay again. Dave added that, in the past, sewer capital costs were spread around the country, whereby small communities were supported by larger ones. Such program no longer exists, however. Eassie noted that the Bureau of Reclamation will match 25 percent of improvement costs, but Hawaii would need to come up with the initial funds and would be competing with other western states.

Glenn asked how long the existing Kahului wastewater facility could be in operation, and Tracy responded that, with structural and operational maintenance, it would be operational for a long time. Dave added that it would be the mechanical and electrical parts that would need upgrade, but concrete structures would strengthen in time. Tracy added they spend $20,000 a year for corrosion protection. Dave stated that sunk costs are for useful life and cost impact analysis would show that.

Glenn felt that Geographic Information System, or GIS, should have been used in the project. The project team responded that 1) GIS was used in understanding growth and settlement patterns, and that 2) GIS will be used when detailed siting studies will be needed.

Future steps

The project team announced that a public information meeting will be held on Thursday, May 12. The project team intends to mail the draft report to the Core Working Group around May 4; each Core Working Group member will receive a hard copy as well as a CD copy. The CWG was asked to get their networks to the meeting. A notice of the meeting will also be posted on the County website.

Dave suggested that a representative should be on the Mayor's TV program. It airs every other Thursday night, and a representative from the Dept. of Public Works could discuss the project and raise community awareness.

APPENDIX B

TECHNICAL MEMORANDUM
CENTRAL MAUI WASTEWATER
INFRASTRUCTURE CAPACITY ASSESSMENT

TECHNICAL MEMORANDUM

CENTRAL MAUI WASTEWATER INFRASTRUCTURE

CAPACITY ASSESSMENT

I. BACKGROUND

The purpose of this memorandum is to assess the capacity of the existing Central Maui wastewater infrastructure. The existing wastewater capacity is an important element of the evaluation process in assessing alternatives to meet future wastewater capacity demands as it serves as the foundation for decision making and scheduling of future infrastructure improvements. This memorandum presents the assumptions and criteria established by the consultant team and the County of Maui to project future wastewater demand and determine possible alternatives to meet these wastewater needs.

Through a series of meetings, the consultant team, in cooperation with the County of Maui and the Core Working Group, was able to establish a foundation of assumptions and criteria necessary for the decision-making, projection, and alternative evaluation processes.

II. ASSUMPTIONS AND CRITERIA

A. General Assumptions

Two general assumptions were made as a precursor to projecting the wastewater demands. First, the planning horizon for this project encompasses the next 25 years until the year 2030. Second, the wastewater collection system and wastewater pump stations capacity adequacy assessment will be evaluated under a separate project, and will not be considered in this study.

B. Population and Land Use Projections

Information and data were collected from a variety of sources to facilitate the consistency and accuracy of the flow projections. The Planning Assessment Technical Memorandum prepared for this study discusses both the socio-economic forecast (i.e. population growth) and land use forecast for the Wailuku-Kahului region from the current point in time until the year 2020. The SMS Socio-Economic Forecast Report prepared in June 2000 for the County Planning Department served as the basis of the planning assessment. This report forecasted population, housing, jobs and visitor variables through the year 2020.

Based on the Planning Assessment, it was determined that the majority of the planned development in the Central Maui region will occur in the Wailuku/Kahului Community Plan areas.

For land use projections, population growth drives the demand for housing units, which in turn increases the need for residential and commercial zoned lands. It was assumed that the vacant single and multi-family acres would remain constant throughout the study. These two assumptions were also used for the projection of commercially-used lands. The number of available units was based on the current Wailuku-Kahului Community Plan. Refer to Appendix A: Central Maui Wastewater Reclamation Facility Study Socio-economic Forecast and land use Forecasts by Munekiyo & Hiraga , Tables 1 through 7.

C. Pump Station Capacity

The capacity of the Wailuku-Kahului Wastewater Service Area Pump Stations (WWPS's) is presented in the document, Kahului Pump Station Data Sheets, provided by the County of Maui Wastewater Reclamation Division (WWRD) (see Appendix B). The peaking factors for the WWPS's are calculated by dividing the Peak Wet Weather Flow (PWWF) by the Average Dry Weather Flow (ADWF), data also found on the data sheets. The WWPS's data presented in the document is used as the basis to determine when each of the WWPS's reaches its design capacity.

D. Historical Flow Data

Flow data for an 18-month period from January 2003 through June 2004 was reviewed to quantify the current wastewater flows received at the Wailuku/Kahului WWRF. The maximum, minimum, and average day effluent discharge flows (Flow data collected from chlorine contact chamber weir) were determined for each month. Table 1 presents the tabulated flow data, which is also shown in Figure 1. Over the 18-month period, there were several flow data points that were out of the ordinary (outliers) in the maximum and minimum flow values. Outliers on the maximum flow curve during January and March 2004 were due to significant rainfall events. January saw approximately 7.9 inches of rainfall in comparison to an average of 3.7 inches. March experienced approximately 8.6 inches of rainfall in comparison to the monthly average of 2.4 inches. Outliers on the minimum flow curve during February 2003 and May 2004 may have resulted from flow meter malfunction. The flow data reflects that the average effluent flow remained relatively steady for the 18 months at approximately 4.9 mgd. The difference between the daily average and the maximum daily average ranged from a minimum of 0.27 mgd during January 2003 to a maximum of 2.0 mgd in January 2004.

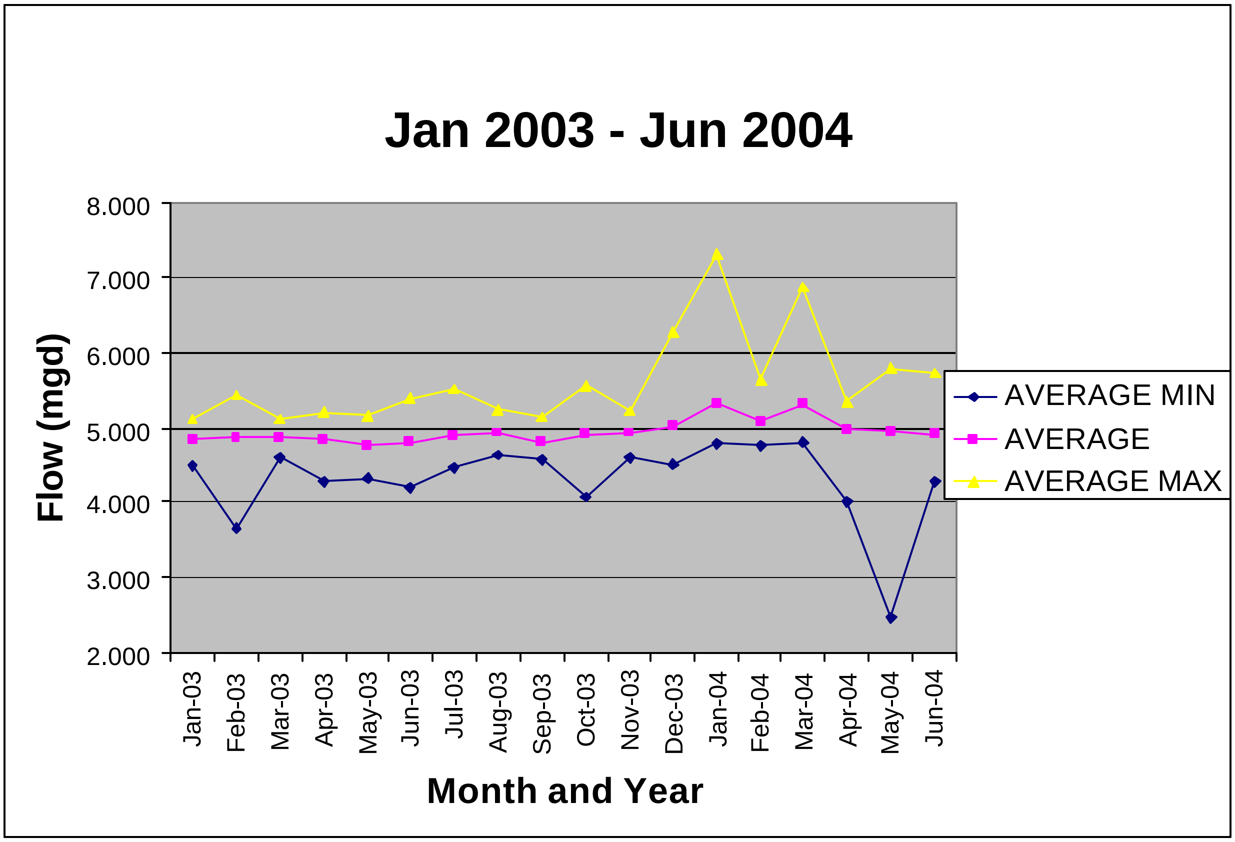
In May 2003, Wilson Okamoto Corporation (WOC) prepared an infrastructure assessment report in support of the County's general plan update program. A component of this report was to evaluate the carrying capacity and adequacy of the County's wastewater system. A comparison of the historical measured flow data and the results of the Wilson Okamoto infrastructure assessment study indicate there is a discrepancy between the historical average daily flow of 4.9 mgd and the findings of the Wilson Okamoto infrastructure assessment study. The WOC report established the current average daily flow for the Wailuku Kahului WWRF at approximately 5.9 mgd (See Figure 3) or 1 mgd higher than the measured current average daily flow.

Table 1 – Wailuku-Kahului WWRF Effluent Flow*

Month	Average (Min)	Average	Average (Max)
	Flow (mgd)		
Jan-03	4.491	4.846	5.118
Feb-03	3.643	4.865	5.430
Mar-03	4.601	4.874	5.124
Apr-03	4.287	4.843	5.190
May-03	4.325	4.752	5.147
Jun-03	4.194	4.802	5.391
Jul-03	4.469	4.893	5.517
Aug-03	4.637	4.917	5.234
Sep-03	4.569	4.809	5.144
Oct-03	4.076	4.898	5.562
Nov-03	4.585	4.917	5.216
Dec-03	4.510	5.009	6.274
Jan-04	4.790	5.333	7.305
Feb-04	4.757	5.075	5.631
Mar-04	4.806	5.307	6.879
Apr-04	4.000	4.979	5.339
May-04	2.460	4.954	5.781
Jun-04	4.276	4.909	5.718

* Chlorine contact chamber

Figure 1 – Wailuku-Kahului WWRF Effluent Flow



E. Underground Injection Control (UIC) Permit

The Wailuku-Kahului WWRF UIC Permit NO. UM-1398 outlines the maximum wastewater flow that the facility can process based on discharge authorized into its effluent injection wells. It has been determined that Permit No. UM-1398 contains erroneous permitted flow values that the WWRD is in the process of rectifying with the Department of Health. The pertinent values from the permit impacting facility capacity are disposal quantity and rate, and the injectant concentration.

- The average disposal quantity shall not exceed 5 million gallons per day (mgd) for every calendar week. **(This value should read as 7.9 mgd).**

- The maximum disposal quantity for each day shall not exceed 7.9 mgd. **(This value should read as 15.8 mgd).**

- 7.9 mgd was assumed to be the maximum capacity of the treatment facility (Source: Wailuku-Kahului Wastewater Reclamation Facility Phase II Modification October 2001).

The permit requires limitations on the injectant concentrations.

- The Biochemical Oxygen Demand (BOD5) shall not exceed 30 milligrams per liter on average, with no individual sample exceeding 60 milligrams per liter.

- The Total Suspended Solids (TSS) shall not exceed 30 milligrams per liter on average, with no individual sample exceeding 60 milligrams per liter.

- The residual chlorine for ever sample shall not be less than 0.1 milligrams per liter (mg/l).

F. Ongoing and Future Development

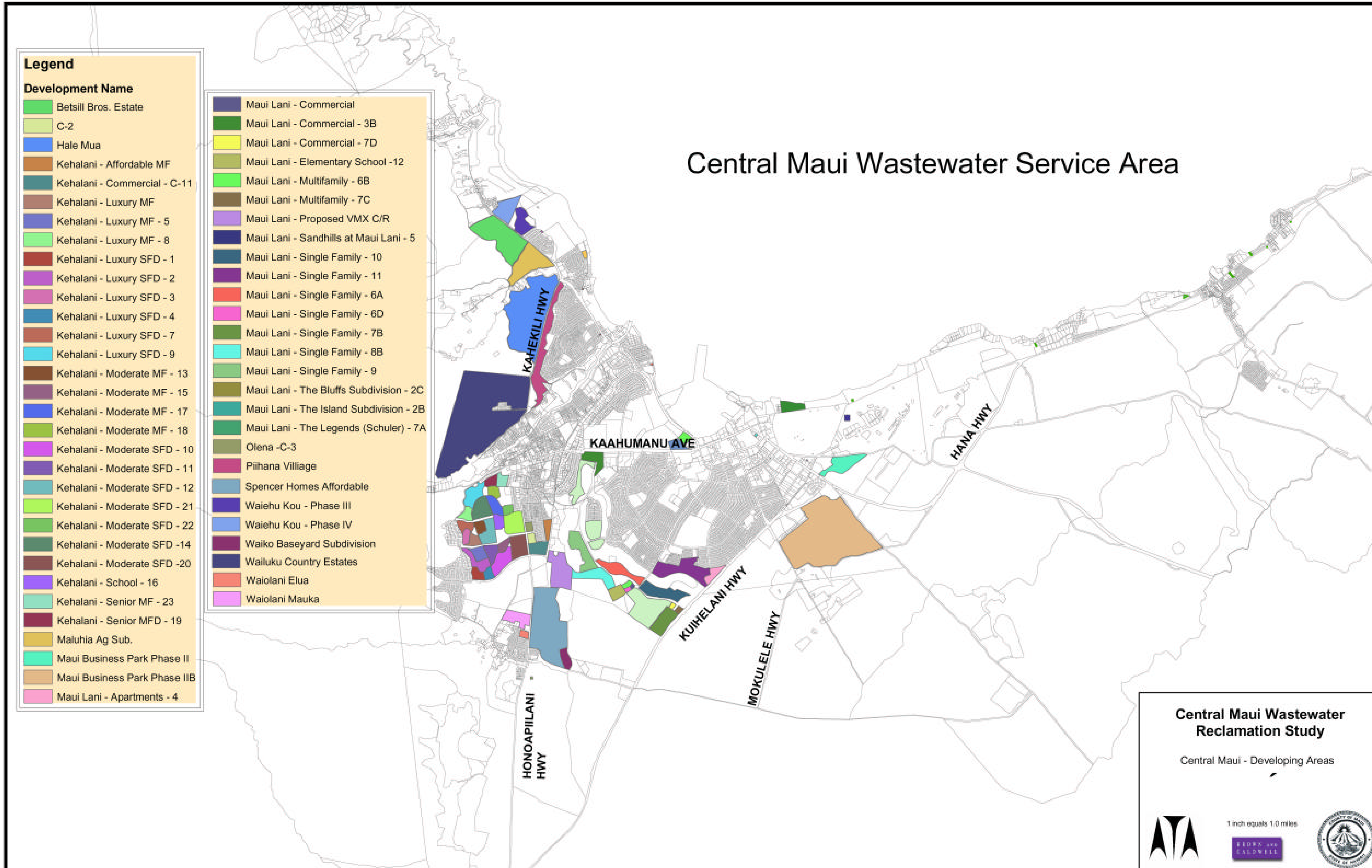
Through discussion with Central Maui developers, the County Planning Department and WWRD, a listing and map showing the proposed development and respective unit counts for the Wailuku/Kahului Wastewater Service Basin were created. Table 2 presents the planned development for the region and the anticipated unit development through 2030. Figure 2 presents the proposed current and future development map for Central Maui through 2030. The map illustrates the current and future development that will require wastewater treatment capacity. An important fact to recognize is that the majority of the planned growth is slated for the Wailuku/Kahului regions of Central Maui and the majority of the development will be completed by 2015.

TABLE 2: Wailuku-Kahului Region Developments

ID	Development Name	Completion Year	Number of Units	YEAR					
				2005	2010	2015	2020	2025	2030
1	Maui Lani - The Island Subdivision - 2B	1/1/2004	89	89	0	0	0	0	0
2	Maui Lani - Commercial - 3B	1/1/2008	0	0	0	0	0	0	0
3	Maui Lani - The Bluffs Subdivision - 2C	1/1/2004	37	37	0	0	0	0	0
4	Maui Lani - Apartments - 4	1/1/2010	238	0	238	0	0	0	0
5	Maui Lani - Sandhills at Maui Lani - 5	1/1/2006	108	0	108	0	0	0	0
6	Maui Lani - Single Family - 6A	1/1/2010	225	0	225	0	0	0	0
7	Maui Lani - Multifamily - 6B	1/1/2010	51	0	51	0	0	0	0
9	Maui Lani - Single Family - 6D	1/1/2010	8	0	8	0	0	0	0
8	Maui Lani - Commercial	1/1/2010	0	0	0	0	0	0	0
10	Maui Lani - The Legends (Schuler) - 7A	1/1/2008	400	0	400	0	0	0	0
11	Maui Lani - Single Family - 7B	1/1/2010	120	0	120	0	0	0	0
12	Maui Lani - Multifamily - 7C	1/1/2010	68	0	68	0	0	0	0
13	Maui Lani - Commercial - 7D	1/1/2010	0	0	0	0	0	0	0
14	Maui Lani - Proposed VMX C/R	1/1/2008	100	0	100	0	0	0	0
15	Maui Lani - Elementary School -12	1/1/2008	0	0	0	0	0	0	0
16	Maui Lani - Single Family - 8B	1/1/2010	35	0	35	0	0	0	0
17	Maui Lani - Single Family - 9	1/1/2012	210	0	210	0	0	0	0
19	Maui Lani - Single Family - 10	1/1/2010	240	0	240	0	0	0	0
20	Maui Lani - Single Family - 11	1/1/2010	260	0	260	0	0	0	0
21	Puuohala Mauka	1/1/2010	187	0	187	0	0	0	0
22	Olena -C-3	1/1/2004	31	31	0	0	0	0	0
23	C-2	1/1/2004	32	32	0	0	0	0	0
24	Kehalani - Commercial - C-11	1/1/2005	0	0	0	0	0	0	0
25	Kehalani - Affordable MF	1/1/2004	32	32	0	0	0	0	0
26	Kehalani - Moderate SFD - 21	1/1/2004	130	130	0	0	0	0	0
27	Kehalani - Moderate SFD -20	1/1/2004	84	84	0	0	0	0	0
28	Kehalani - Moderate SFD - 22	1/1/2008	35	0	35	0	0	0	0
29	Kehalani - Senior MF - 23	1/1/2009	119	0	119	0	0	0	0
30	Kehalani - Moderate MF - 18	1/1/2012	150	0	0	150	0	0	0

TABLE 2: Wailuku-Kahului Region Developments (continued)

ID	Development Name	Completion Year	Number of Units	YEAR					
				2005	2010	2015	2020	2025	2030
31	Kehalani - Senior MFD - 19	1/1/2010	70	0	70	0	0	0	0
32	Kehalani - Luxury SFD - 9	1/1/2011	95	0	0	95	0	0	0
33	Kehalani - Luxury MF - 8	1/1/2011	122	0	0	122	0	0	0
34	Kehalani - Luxury SFD - 1	1/1/2004	33	33	0	0	0	0	0
35	Kehalani - Luxury SFD - 2	1/1/2006	60	0	60	0	0	0	0
36	Kehalani - Luxury SFD - 4	1/1/2004	33	33	0	0	0	0	0
37	Kehalani - Luxury MF - 5	1/1/2007	120	0	120	0	0	0	0
38	Kehalani - Luxury SFD - 7	1/1/2008	43	0	43	0	0	0	0
40	Kehalani - Luxury SFD - 3	1/1/2009	30	0	30	0	0	0	0
41	Kehalani - Luxury MF	1/1/2009	60	0	60	0	0	0	0
42	Kehalani - Moderate SFD - 10	1/1/2006	85	0	85	0	0	0	0
43	Kehalani - Moderate MF - 17	1/1/2013	140	0	0	140	0	0	0
44	Kehalani - Moderate SFD -14	1/1/2011	77	0	0	77	0	0	0
44	Kehalani - Moderate MF - 13	1/1/2010	70	0	70	0	0	0	0
45	Kehalani - Moderate SFD - 12	1/1/2009	122	0	122	0	0	0	0
46	Kehalani - School - 16	1/1/2009	0	0	0	0	0	0	0
47	Kehalani - Moderate MF - 15	1/1/2005	150	150	0	0	0	0	0
48	Kehalani - Moderate SFD - 11	1/1/2007	65	0	65	0	0	0	0
49	Waiehu Kou - Phase III	1/1/2005	90	90	0	0	0	0	0
50	Spencer Homes Affordable	1/1/2010	410	0	0	410	0	0	0
51	Waiolani Mauka	1/1/2010	108	0	54	54	0	0	0
52	Waiko Baseyard Subdivision	1/1/2030	0	0	0	0	0	0	0
53	Waiolani Elua	1/1/2005	25	25	0	0	0	0	0
54	Betsill Bros. Estate	1/1/2030	0	0	0	0	0	0	0
55	Waiehu Kou - Phase IV	1/1/2010	93	0	93	0	0	0	0
55	Hale Mua	1/1/2015	465	233	0	232	0	0	0
56	Maluhia Ag Sub.	1/1/2030	0	0	0	0	0	0	0
57	Maui Business Park Phase IIB	1/1/2030	0	0	0	0	0	0	0
58	Maui Business Park Phase II	1/1/2030	0	0	0	0	0	0	0
60	Piihana Village	1/1/2030	390	0	0	97	97	97	99
	Total Units		5945	999	3276	1377	97	97	99


Central Maui Wastewater Service Area
Legend
Development Name
Betsill Bros. Estate
C-2
Hale Mua
Kehalani - Affordable MF
Kehalani - Commercial - C-11
Kehalani - Luxury MF
Kehalani - Luxury MF - 5
Kehalani - Luxury MF - 8
Kehalani - Luxury SFD - 1
Kehalani - Luxury SFD - 2
Kehalani - Luxury SFD - 3
Kehalani - Luxury SFD - 4
Kehalani - Luxury SFD - 7
Kehalani - Luxury SFD - 9
Kehalani - Moderate MF - 13
Kehalani - Moderate MF - 15
Kehalani - Moderate MF - 17
Kehalani - Moderate MF - 18
Kehalani - Moderate SFD - 10
Kehalani - Moderate SFD - 11
Kehalani - Moderate SFD - 12
Kehalani - Moderate SFD - 21
Kehalani - Moderate SFD - 22
Kehalani - Moderate SFD -14
Kehalani - Moderate SFD -20
Kehalani - School - 16
Kehalani - Senior MF - 23
Kehalani - Senior MFD - 19
Maluhia Ag Sub.
Maui Business Park Phase II
Maui Business Park Phase IIB
Maui Lani - Apartments - 4
Maui Lani - Commercial
Maui Lani - Commercial - 3B
Maui Lani - Commercial - 7D
Maui Lani - Elementary School -12
Maui Lani - Multifamily - 6B
Maui Lani - Multifamily - 7C
Maui Lani - Proposed VMX C/R
Maui Lani - Sandhills at Maui Lani - 5
Maui Lani - Single Family - 10
Maui Lani - Single Family - 11
Maui Lani - Single Family - 6A
Maui Lani - Single Family - 6D
Maui Lani - Single Family - 7B
Maui Lani - Single Family - 8B
Maui Lani - Single Family - 9
Maui Lani - The Bluffs Subdivision - 2C
Maui Lani - The Island Subdivision - 2B
Maui Lani - The Legends (Schuler) - 7A
Olena -C-3
Piihana Villiage
Spencer Homes Affordable
Waiehu Kou - Phase III
Waiehu Kou - Phase IV
Waiko Baseyard Subdivision
Wailuku Country Estates
Waiolani Elua
Waiolani Mauka
KAHEKILI HWY
KAAHUMANU AVE
HANA HWY
KUIHELANI HWY
MOKULELE HWY
HONOAPIILANI HWY
Central Maui Wastewater Reclamation Study
Central Maui - Developing Areas
1 inch equals 1.0 miles

G. Wastewater Flow Assumptions and Projection

Several assumptions were made in developing the wastewater flow projection. First, each residential unit will have on average 2.7 persons based on a mix of the various types of residential development. The average occupancy is based on Brown and Caldwell's master plan experiences. Second, each person contributes 137 gallons of wastewater per day (gpd) (Wilson Okamoto Report). To account for the impact of ohana dwellings, the residential count was increased by 10 percent for each development.

Population and land use projections, capacity values, peaking factors, total flow data, permit guidelines and regional developments were used along with these assumptions to generate the wastewater flow projections utilizing the Capacity Assurance Planning Environment (CAPE) software. CAPE is an integrated set of software tools designed to support the Capacity Assurance Planning master planning process.

CAPE is a program capable of calculating the amount of wastewater flow generated in a region based on GIS data. A shapefile of planned developments in the Central Maui area was created in ArcView. Each planned development was assigned a number of units based on information available from developers and County of Maui staff.

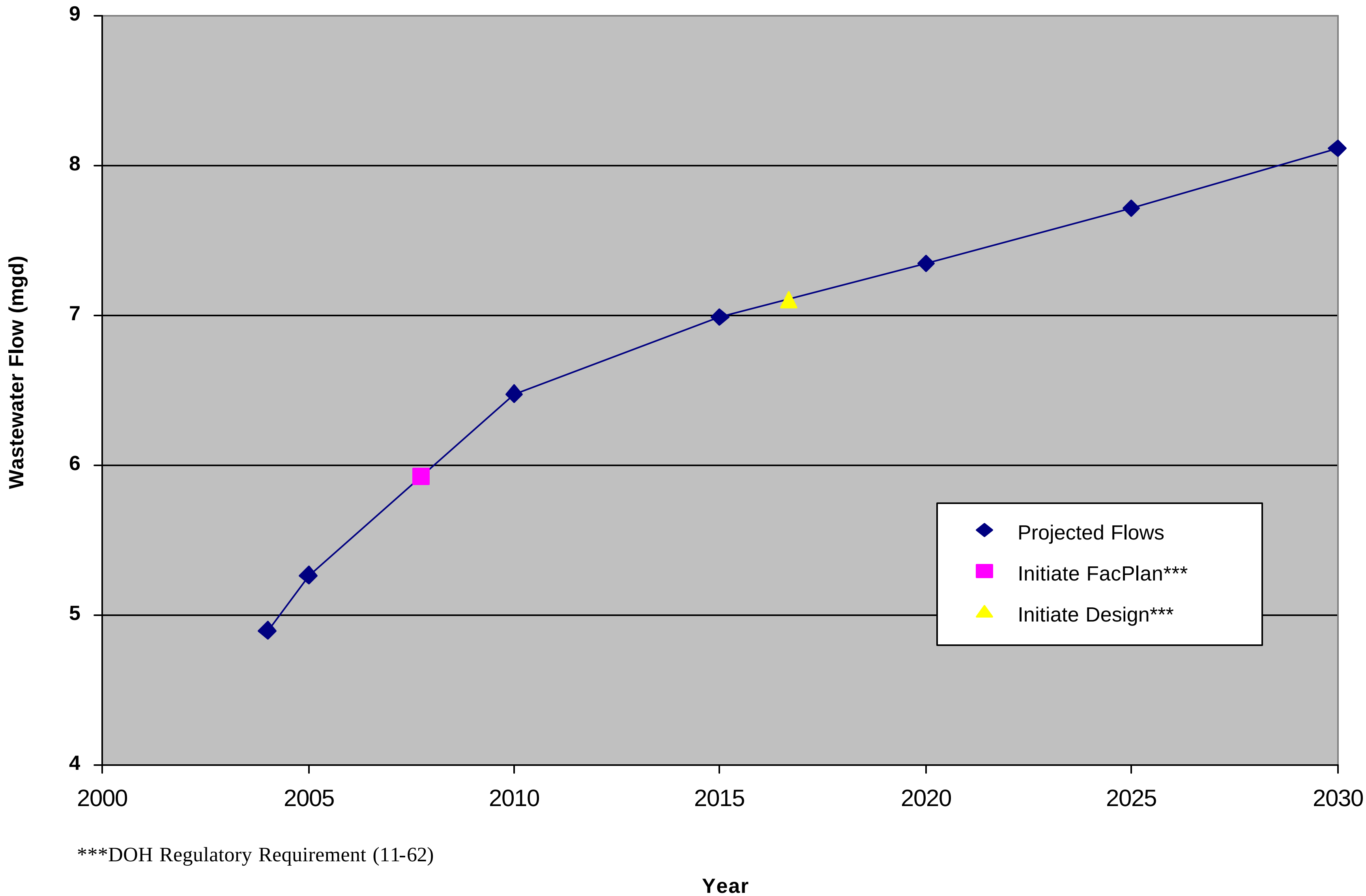
The shapefile of the developments was converted to a grid file for use in CAPE. A grid file is a data format that stores a value in equally sized squares and is typically used for calculations. The grid used in CAPE stored population. The population was calculated by multiplying the number of units per development by 2.7 occupants per unit.

The wastewater flow rate per capita was input into CAPE's forecast model. The wastewater forecast for the Central Maui area is the population stored in the grid file multiplied by the volume of wastewater generated by each person or 137 gallons per capita per day.

CAPE is also able to project how the WWPS's are impacted by the additional flows. Figure 3 presents the projected wastewater flows through the year 2030 using the measured base flow of 4.9 mgd. Figure 3 indicates that rate of development in Central Maui will peak by 2015 and taper off through the year 2030. Projected wastewater flows beyond 2105 was adjusted to incorporate the results of the recently released "Population and Economic Projections for State of Hawaii to 2030" prepared by the Department of Business and Economic Development and Tourism August 2004. The report projects that the population for Maui will increase by 1% per year through 2030. The two important regulatory trigger points are highlighted in Figure 3 that indicates when a Facilities Plan and Design of additional capacity must commence.

Understanding that Figure 3 represents a "best guess" forecast, the status of the known planned future development projects should be updated regularly to reflect the developer's current plan and schedule so the impact on wastewater facilities can be monitored. Also, as new developments are identified in the Central Maui region, they should be incorporated into the forecast. Such updates could be easily entered into CAPE, resulting in the most current flow forecasts.

Figure 3 - Wailuku-Kahului WWRF Flow Projections



***DOH Regulatory Requirement (11-62)

III. WASTEWATER SYSTEM ALTERNATIVES

The process to establish a foundation of social, environmental and site development criteria was implemented through a number of meetings/workshops with the County study team. The result of this process served as an important element in guiding the development of potential alternatives. This action ensures that the community concerns are integrated into the study decision making.

The projects consultant team and the WWRD team, composed of WWRD staff and Planning Department staff, created a list of constraints and issues that should be considered during the decision-making and alternative development phases.

- Public / Private Partners
  - Impact on OM&R budget – sewer user needs.
  - Funding resources – impact on other CIP needs.
- Wastewater flow distribution – existing vs. new.
- Disposal concerns.
- Peak wastewater flows.
- Natural / Environmental issues – tsunami zone / erosion.
- Recycled water use / quality of water.
- Site of plant location.
- Community acceptance.
- Staff requirements for new wastewater reclamation facility

To mitigate the identified project constraints, the WWRD Team outlined a list of program values that would serve as the guiding principles for future group decisions. The guiding principles are:

- Minimize “negative” Environmental Impacts (see below).
- Maximize water / solids recycling.
- Balance Financial Impacts on community; take funding away from other projects to support costs.
- “Land Use” compatibility of new wastewater facility site.
- Allow for expansion of service area.
- Reduce inflow and infiltration (I / I)
- Develop proactive plan that meets community needs.
- Demand management – Water Conservation.
- Improve quality of life for Maui
- Blend Wastewater Reclamation Facility into community setting.

The WWRD Team further defined, Environmental Impact, as follows:

- Little or no degradation to near shore waters.
- Reduce odor impacts.
- Reduce noise impacts.
- Reduce traffic impacts.
- Mitigate sludge hauling.
- Project energy requirements needed by new facilities.
- Predict wastewater spill potential.

In summary, the goal of the environmental criteria is to have little or no disruption to the current habitat/conditions when new developments and/or rehabilitation changes are made.

To start the alternatives development process, the WWRD Team participated in an exercise to define an initial list of potential alternatives to meet the guiding principles and future wastewater demands. Through collective open discussion, seven alternatives were presented as noted below:

- Expand existing facilities and fortify / strengthen.
- Construct satellite treatment facilities as new development.
- All new development by constructing individual wastewater plants / systems.
- Construct new central plant and redirect portion of flow; keep / convert existing treatment plant.
- Construct new treatment plant and abandon / convert old plant into a pump station.
- No Build / Do Nothing / Postpone development.
- Incorporate Kanaha Pond as part of treatment process; continue use of reclaimed water from pond.

To ensure a consistent understanding of alternatives Table 3 was created.

Table 3 – Wailuku-Kahului WWRF Alternative Descriptions

Alternative	Description
New Capacity Alternatives	
Expand existing Wailuku/Kahului WWRF for future capacity; strengthen WWRF for tsunami/ erosion concerns	The existing WWRF will continue to serve as Central Maui's wastewater treatment facility. The facility will be expanded to meet future wastewater capacity demands as required. The facility will be strengthened to address tsunami and shoreline erosion concerns.
Maintain existing Wailuku/Kahului WWRF; strengthen WWRF for tsunami / erosion concerns. Construct satellite WWRF(s) for future capacity	The existing WWRF will remain in operation at its current capacity and fortified to address tsunami and shoreline erosion concerns. Future Central Maui wastewater treatment demands will be met by constructing satellite WWRF(s) in the Central Maui region and recycling the treated effluent.
Maintain existing Wailuku/Kahului WWRF; strengthen WWRF for tsunami/ erosion concerns. Develop smaller individual wastewater systems for future capacity	The existing WWRF will remain in operation at its current capacity and fortified to address tsunami and shoreline erosion concerns. Future Central Maui wastewater treatment demands will be met by requiring new development to construct individual wastewater systems.
Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing Wailuku/Kahului WWRF	The existing Wailuku/Kahului WWRF will be phased out and a new regional Central Maui WWRF will be constructed to meet the existing and future wastewater treatment demands.
Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone	A new WWRF will be constructed to meet future wastewater treatment demands and a new WWRF will be constructed out of the tsunami and shoreline erosion zone to replace the existing WWRF.
No Build/ Do nothing	No Action
Introduce Kanaha Pond for polishing treatment process/ reclaimed effluent	The existing WWRF will continue to serve as Central Maui's wastewater treatment facility. The facility will be fortified to address tsunami and shoreline erosion concerns. The WWRF will be expanded to meet future wastewater treatment demands in conjunction with using Kanaha Pond as an effluent polishing wetlands type operation. The treated effluent would be collected and recycled for irrigation purposes.
Maintain existing Wailuku/Kahului WWRF; strengthen WWRF for tsunami/ erosion concerns. Construct deep ocean outfall for effluent disposal	The existing WWRF will serve as Central Maui's wastewater treatment facility. The facility will be expanded to meet future wastewater treatment demands. The facility will be fortified to address tsunami and shoreline erosion concerns. A deep ocean outfall would be constructed to replace the existing effluent injection wells.

Table 3 – Wailuku-Kahului WWRF Alternative Descriptions (continued)

Alternative	Description
Demand Side Alternatives	
Initiate water conservation / Produce less waste	In partnership with the Department of Water Supply initiate a comprehensive water conservation program to reduce wastewater flows.
Replace existing water fixtures	Develop and implement a fixture replacement program to replace toilet fixtures, shower heads, etc to reduce wastewater flows.
Reduce infiltration / inflow	Develop and implement a comprehensive I/I reduction program to reduce the introduction of groundwater and rainwater into the wastewater system.

An initial Alternative Prioritization Exercise was undertaken to preliminarily assess what the WWRD staff believes is the most appropriate alternative to meet the Central Maui future wastewater demands. Table 4 presents the results of the exercise. The results indicate which alternative is viewed as being most effective in accomplishing the project objectives. This exercise was done without consideration of evaluation criteria that was being developed by the Core Working Group.

Table 4 – Central Maui WW Capacity Alternatives Prioritization

Alternative #	Evaluator									Number of Votes	Total
	1	2	3	4	5	6	7	8	9		
1	1	1	1	3	x	2	4	1	1	8	14
2	3	2	2	2	3	4	1	2	2	9	21
3	x	3	4	4	5	5	x	x	3	6	24
4	2	x	5	x	2	1	2	5	4	7	21
5	x	x	x	x	1	x	3	4	5	4	13
6	5	5	x	1	x	x	5	x	x	4	16
7	4	4	3	x	x	3	x	3	x	5	17

Notes: 5 point scale with 5 being highest, 1 being lowest
Each evaluator to chose top 5 alternatives and rank accordingly

List of Alternatives:

1. Expand existing facilities and fortify / strengthen.

2. Construct satellite treatment facilities as new development.

3. All new development by constructing individual wastewater plants / systems.

4. Construct new central plan and redirect portion of flow; keep / convert existing treatment plant.

5. Construct new plan and abandon / convert old plant into pump station.

6. No Build / Do Nothing / Postpone development.

7. Incorporate Kanaha Pond as part of treatment process; continue use of reclaimed water from pond.

During a subsequent meeting, the WWRD Team continued its discussion of the alternative evaluation matrix including the review of evaluation criteria established by the Core Working Group. The revised matrix from the meeting was used to present to the Core Working Group in finalizing the Alternatives Evaluation Criteria. The Central Maui Wastewater Reclamation Facility Project: Decision Matrix is presented in Appendix C.

APPENDIX A

Central Maui Wastewater Reclamation Facility Study

Socio-Economic Forecast and Land Use Forecasts,

Munekiyo and Hiraga 2004

SOCIO-ECONOMIC FORECAST AND LAND USE FORECASTS

I. INTRODUCTION

Austin, Tsutsumi & Associates, Inc., (ATA), on behalf of the County of Maui, has been contracted to produce a study for the Central Maui Wastewater Reclamation Facility. The purpose of the study is to develop a master plan that meets the region's long-term wastewater infrastructure needs.

One component of this study involves research and analysis of available planning related information and data which is pertinent to the master plan development process. Such information includes socio-economic forecasts and land use forecasts which will assist to define facility design criteria. As such, this report will document findings relating to Task 2 - Data Gathering, Section 2.1 - Planning Related Data of the Scope of Work for the study. Specifically, this task states:

> *Coordinate with State and County agencies to obtain available socio-economic and land use forecast information data. Agencies to be consulted would include the County Planning Department, County Office of Economic Development, and State Department of Business, Economic Development and Tourism.*

II. PLANNING CONTEXT AND ASSUMPTIONS

The 1990 update of the Maui County General Plan establishes broad objectives and policies to guide the long-range development of the County. As indicated by the Maui County Charter, the purpose of the general plan shall be to:

> *"... indicate desired population and physical development patterns for each island within the county; shall address the unique problems and needs of each island and region within the county; shall explain the opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns, and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies and implementing actions to be pursued with respect to population density, land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design, and other matters related to development."*

Towards implementing the General Plan, a regional planning framework has been created with formulation of nine (9) community plans. The island of Maui is divided into six (6) community plan areas, with the islands of Kahoolawe, Lanai and Molokai comprising separate community plan regions. Each community plan incorporates objectives and policies which advance those found in the General Plan.

From a locational standpoint, the Central Maui Wastewater Reclamation Facility Study primarily affects the Wailuku-Kahului Community Plan region. Alternative scenarios for the Central Maui Wastewater Reclamation Facility development may also affect the Kihei-Makena Community Plan region. For example, if wastewater flows from the Kihei-Makena region are diverted to a new facility located within the Wailuku-Kahului Community Plan region, population and land use considerations from wastewater flow contribution areas outside of the Wailuku-Kahului Community Plan region must be considered.

For purposes of this working paper, it is assumed that scenarios formulated for the Central Maui Wastewater Reclamation Facility will affect the Wailuku-Kahului Community Plan area only. Should flows be diverted from other community plan regions, those flows are further assumed to be fixed (i.e., a not to exceed quantity) which will not be subject to socio-economic and land use forecasts beyond the Wailuku-Kahului Community Plan region.

With respect to the Wailuku-Kahului Community Plan, the following objectives/policies and implementing actions pertain to the Central Maui Wastewater Reclamation Facility:

<u>Objectives and Policies</u>

1. *Coordinate sewer system improvement plans with future growth requirements, as defined in the Community Plan.*

* * *

4. *Reuse the treated effluent from the County's waste water treatment system for irrigation and other suitable purposes in a manner that is environmentally sound.*

<u>Implementing Actions</u>

* * *

2. *Explore feasibility of extending sewer service to unserviced areas as part of comprehensive sewer system planning.*

3. *Investigate the feasibility of constructing a wastewater treatment facility for the Central Maui area to service the future needs of population growth. Locations to be investigated include the airport area, the Pu`un n sugar mill area, and other areas east of*

Kuihelani Highway. Site conditions to be evaluated shall include, but not be limited to, potential odor problems with surrounding neighborhoods, corrosive environments, effluent disposal, groundwater contamination and project costs.

4. *Relocate the Kahului Wastewater Treatment Plant out of the tsunami zone.*

III. POPULATION PROJECTIONS

In June 2002, SMS prepared a Socio-Economic Forecast Report for the County of Maui. This report included forecasts on population, housing, jobs and visitor variables through 2020 for eight (8) Community Plan regions in Maui County. The model was derived from various sources including the previous socio-economic forecast by Community Resources, Inc. (1992); the Department of Business, Economic Development and Tourism long- and short-term forecasts; U.S. Census data; Hawaii State Department of Labor and Industrial Relations data; and Hawaii Health Survey data for 2000.

The Maui island resident and defacto population projections are presented in Table 1 and Table 2:

Table 1

MAUI ISLAND RESIDENT POPULATION PROJECTIONS					
Hist.	**Hist.**	**Projected**			
1990	**2000**	**2005**	**2010**	**2015**	**2020**
91,361	117,664	127,950	138,665	149,477	160,090
Source: SMS, Socio Economic Forecast, June 2002.					

Table 2

MAUI ISLAND DEFACTO POPULATION PROJECTIONS					
Hist.	**Hist.**	**Projected**			
1990	**2000**	**2005**	**2010**	**2015**	**2020**
124,263	156,170	169,882	184,110	198,495	212,629
Source: SMS, Socio Economic Forecast, June 2002.					

Island-wide resident population is further broken down into Community Plan districts. Table 3 summarizes the residential population projections for the Wailuku-Kahului Community Plan region.

Table 3

WAILUKU-KAHULUI RESIDENTIAL POPULATION PROJECTIONS					
Hist.	**Hist.**	**Projected**			
1990	**2000**	**2005**	**2010**	**2015**	**2020**
32,816	41,503	44,883	48,397	51,943	55,424
Source: SMS, Socio Economic Forecast, June 2002.					

Defacto population was not estimated for any of the eight (8) Community Plan regions in the SMS study. It is assumed that defacto population was not broken down because both residents and visitors move among the Community Plan regions in complex ways every day. Therefore, modeling defacto population by calculating resident population, minus the number normally absent, plus the average visitor census would involve methodological assumptions for which reliable data is not available.

Nonetheless, a conservative (high side) approach to calculating defacto population for a region can be assumed by adding the average visitor census to the share of on-island residents for a particular region. Table 4 provides the average visitor census for the Wailuku-Kahului Community Plan to the 2020 horizon year. The defacto population estimates are presented in Table 5.

Table 4

WAILUKU-KAHULUI AVERAGE VISITOR CENSUS					
Hist.	**Hist.**	**Projected**			
1990	**2000**	**2005**	**2010**	**2015**	**2020**
1,294	1,180	1,515	1,860	2,397	2,940
Source: SMS, Socio Economic Forecast, June 2002.					

Table 5

WAILUKU-KAHULUI DEFACTO POPULATION[a]					
Hist.	**Hist.**	**Projected**			
1990	**2000**	**2005**	**2010**	**2015**	**2020**
34,110	42,683	46,398	50,257	54,340	58,364

[a] Totals represent summation of estimates presented in Table 3 and Table 4.

IV. LAND USE FORECAST

In April 2003, the County of Maui Planning Department, Long Range Planning Division, prepared a Land Use Forecast Technical Study. The objective of this study was to develop an inventory of existing land uses and determine land use requirements by major land use categories for target years 2005, 2010, 2015, and 2020. For purposes of this report, residential and hotel land use forecast was extracted from the Land Use Forecast Technical Study as they deal with population and visitor projections which in turn are the key parameters for wastewater flow projections.

A residential land use forecast was done for each Community Plan region. It is assumed that growth in population drives the demand for housing units, which in turn increases the need for residentially zoned lands. Based on this study, there are 995 vacant single-family acres and 20 vacant multi-family acres. Assuming that these numbers remain constant throughout the study period, estimates provided in Table 6 indicate demand and surplus/deficit for residential land acreage requirements:

Table 6

NET RESIDENTIAL LAND REQUIREMENTS (IN ACRES)				
Year	**Single -Family Demand**	**Single -Family Surplus/(Deficit)**	**Multi-Family Demand**	**Multi-Family Surplus/(Deficit)**
2005	326	669	7	13
2010	633	362	9	11
2015	940	55	13	7
2020	1,252	(257)	18	2

Source: Land Use Forecast Technical Study, April 2003.

Based on this analysis, existing single-family designated lands can accommodate future growth to the year 2015, while existing multi-family designated lands can accommodate future growth beyond 2020 for the Wailuku-Kahului region.

As with the residential land use analysis, it is assumed that visitor population drives the need for transient accommodations or visitor units, which in turn generates the demand for hotel-designated lands. The study indicates that the Wailuku-Kahului region has 2 acres of vacant hotel-designated lands. Assuming that this number remains constant throughout the study period, estimates provided in Table 7 indicate demand and surplus/deficit in acres for hotel land requirements:

Table 7

NET HOTEL LAND REQUIREMENTS (IN ACRES)		
Year	**Hotel Demand**	**Hotel Surplus/(Deficit)**
2005	7	(5)
2010	13	(11)
2015	25	(23)
2020	37	(35)
Source: Land Use Forecast Technical Study, April 2003.		

Based on this analysis, there will be a need for 5 acres of hotel-designated lands in the year 2005, increasing to a deficit of 35 acres in 2020.

V. WAILUKU-KAHULUI WASTEWATER SYSTEM

In May 2003, Wilson Okamoto & Associates (WOA) prepared an infrastructure assessment report in support of the County's general plan update program. One of the components examined in this report is the Wailuku-Kahului Wastewater Reclamation Facility (WWRF).

The Wailuku-Kahului WWRF serves the communities of Kahului, Wailuku, Paia, Kuau and Spreckelsville. The Wailuku-Kahului WWRF has a design capacity of 7.9 mgd average dry-weather flow (ADWF), of which 6.958 mgd, or 88 percent, of its rated ADWF capacity has been allocated.

The overall objective of the WWRF portion of WOA's assessment report was to determine required upgrades for the County wastewater systems and to assess whether the systems will experience capacity constraints based on the population and visitor forecasts provided in the SMS Socio-Economic Forecast Study (2002).

Wastewater flows were projected based on resident population and average visitor census projections. Wastewater flow projections were separated by visitor wastewater flows and resident wastewater flows. To project visitor wastewater flows, a wastewater generation rate of 156 gallons per visitor day was used as recommended by the County's Wastewater Reclamation Division Policy/Guideline for Standards of Wastewater Contribution. To project resident wastewater flows, historical wastewater flows were used to derive a per capita flow rate for each County Wastewater Reclamation Facility (WWRF). For the Wailuku-Kahului WWRF, a resident per capita flow rate of 137 gpd was used. Results of projection estimates are posted in Table 8.

Table 8

WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY
PROJECTED WASTEWATER FLOWS (BASELINE PROJECTIONS)

Year	Resident Population	Visitor Population	Resident Flows (mgd)	Visitor Flows (mgd)	Total Flows (mgd)
2005	44,883	1,515	6.14	.23	6.37
2010	48,397	1,860	6.63	.29	6.92
2015	51,943	2,397	7.11	.37	7.48
2020	55,424	2,940	7.59	.45	8.04

Source: SMS, Socio Economic Forecast Report, June 2002.
Wilson Okamoto Corporation, Infrastructure Assessment Update.

VI. OTHER PROJECTIONS

In reviewing socio-economic and land use forecasts, residential population projections become constrained (by Community Plan land use designations) in year 2020, at which time demand for single-family land acreage exceeds supply. Refer to Table 6. Visitor counts become constrained as early as 2005 when land use acreage for hotel demand exceeds supply. Refer to Table 7. Since visitor wastewater flows are a small percentage of the overall flow, the visitor count constraint should not be viewed as a significant factor in calculating future wastewater capacity.

Nonetheless, the County's Socio-Economic Forecast included visitor population growth beyond 2005 by using a "low projection" assumption and a "high projection" assumption. The low projection assumption utilizes a visitor growth rate which is one-half that of the baseline growth rate developed for Maui County by the Department of Business Economic Development and Tourism. The high projection assumption utilizes a visitor growth rate which increases at one-and-a-half times the baseline rate. Using the low and high projection assumptions, wastewater flow projections combining resident population and visitor estimates through the year 2020 have been compiled, as reflected in Tables 9 and 10, respectively.

Table 9

WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY PROJECTED WASTEWATER FLOWS (LOW PROJECTIONS)

Year	Resident Population	Visitor Population	Resident Flows (mgd)	Visitor Flows (mgd)	Total Flows (mgd)
2005	44,657	1,326	6.11	.20	6.31
2010	47,930	1,438	6.56	.22	6.78
2015	51,176	1,718	7.01	.26	7.27
2020	54,365	1,978	7.44	.30	7.74

Source: SMS Socio-Economic Forecast Report, June 2002.
Wilson Okamoto & Associates, Infrastructure Assessment Update.

Table 10

WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY PROJECTED WASTEWATER FLOWS (HIGH PROJECTIONS)

Year	Resident Population	Visitor Population	Resident Flows (mgd)	Visitor Flows (mgd)	Total Flows (mgd)
2005	45,093	1,708	6.17	.26	6.43
2010	48,891	2,308	6.69	.36	7.05
2015	52,777	3,143	7.23	.49	7.72
2020	56,647	4,037	7.76	.62	8.38

Source: SMS Socio-Economic Forecast Report, June 2002.
Wilson Okamoto & Associates, Infrastructure Assessment Update.

It is noted that the projections presented herein are based on socio-economic forecasts formulated in the year 2002 and that adjustments in forecast data are required to incorporate newly proposed projects (as described below.) Such adjustments are particularly appropriate for consideration when undertaking detailed engineering studies relating to facility-specific capacities. Therefore, methodological adjustments for projecting wastewater flows based on the most current information and technical data available are warranted and deemed prudent for this project. It is in this context that the engineers review and update flow projections in order to present a realistic basis for decision making.

VII. PROPOSED DEVELOPMENTS

When analyzing projections, it is important to note proposed developments. The following is a list of project names and estimated unit counts within the Wailuku-Kahului Region that can be assumed to be constructed within a 10 to 15 year time period.

Waiehu Kou .... 93± units

Hale Mua (Sterling Kim) .... 465± units

Waiolani Mauka .... 108± units

Wailuku Project District 1 (Maui Lani) .... 2,800± units

Wailuku Project District 2 (Piihana) .... 390± units

Wailuku Project District 3 (Wailuku) .... 2,000± units

Wailuku Country Estates .... 187± units

Waikapu Affordable Housing .... 410± units

It is noted that those projects which are italicized are located on lands which are not designated residential use by the Wailuku-Kahului Community Plan.

VIII. CONCLUSION

As mentioned in the introduction section of this report, this study involves research and analysis of <u>available</u> planning related information and data. It is acknowledged that the socioeconomic and land use forecast data may continually be updated by the Department of Planning as part of the 2000 General Plan Amendment process. Should these technical studies be updated, the numerical analysis contained in this report should be updated as well.

In the context of projecting future wastewater treatment capacity demands, projections are not limited to the methodology established by Wilson Okamoto & Associates (now known as Wilson Okamoto Corporation). The study team evaluated recent historical wastewater flows (January 2003 – June 2004) treated by the Wailuku-Kahului WWRF and updated developer driven project plan schedules to update the Wilson Okamoto Corporation future wastewater treatment capacity demand requirements. The result of this exercise indicates the County's wastewater allocation records are higher than actual flows for 2005 and caused the wastewater treatment capacity requirements to be accelerated. For this study the consultant team used the results of its evaluation to project future Wailuku-Kahului wastewater capacity demands.

APPENDIX B

Kahului Pump Station Data Sheets

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

A & B P. S.	Alamaha St. & Wakea Ave. Kahului, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	450	0.76	0.21	28%	0.51	67%			Calculation		2002
2002	450	0.76	0.23	30%	0.56	73%	0.020		Calculation	9%	2003
2003	450	0.76	0.22	29%	0.54	71%	-0.008		Pump Run Time	-3%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (2.43)

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Hawaiian Homes P. S.	Waiehu Beach Rd. & Kukona Pl. Wailuku, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd) *	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	1557	2.230	0.90	40%	1.78	80%		0	Calculation		2002
2002	1557	2.230	0.97	43%	1.92	86%	0.07		Calculation	7%	2003
2003	1557	2.230	1.02	46%	2.02	91%	0.05	N/A	Pump Run Times	5%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (1.98)

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Kaa P. S. Amala Pl. & Alaho St.
Kahului, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	1200	1.11	0.34	31%	1.02	92%		2	Field Test		2002
2002	1200	1.11	0.32	28%	0.95	85%	-0.02		Calculation	-8%	2003
2003	1200	1.11	0.36	32%	1.07	96%	0.04002		Pump Run Times	11%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (2.97)

COUNTY OF MA[illegible]
WASTEWATER RECLAMAT[illegible]IVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Kahului P. S.	Hana Hwy & Hobron Ave. Kahului, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	4900	6.800	1.700	25%	3.672	54%		1	Field Test		2002
2002	4900	6.800	0.000		0.000						2003
2003	4900	6.800	0.786	12%	1.699	25%	N/A	1	Flow Meter	N/A	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (2.16)

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Kuau P. S. No.3	Hana Hwy. & Lae Pl. Kuau, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	430	0.62	0.055	9%	0.14	23%		0	Calculation		2010
2002	430	0.62	0.037	6%	0.09	15%	-0.02		Calculation	-51%	2003
2003	430	0.62	0.061	10%	0.16	25%	0.02		Pump Run Times	40%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (2.62)

COUNTY OF M[illegible]
WASTEWATER RECLAMA[illegible] DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Kuau P. S. No.4 Hana Hwy. & Holo Pl.
Kuau, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	430	0.62	0.055	9%	0.14	23%		0	Calculation		2002
2002	430	0.62	0.065	10%	0.16	27%	0.010		Calculation	15%	2003
2003	430	0.62	0.052	8%	0.13	21%	-0.013		Pump Run Times	-24%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (2.50)

COUNTY OF M[illegible]
WASTEWATER RECLAMA[illegible] DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Sprecklesville P. S. Laulea Pl. & Alapaka Pl.
Kahului, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	1000	1.44	0.274	19%	1.02	71%		2	Field Test		2002
2002	1000	1.44	0.36	25%	1.35	94%	0.1		Calculation	24.5%	2003
2003	1000	1.44	0.38	26%	1.40	97%	0.01		Pump Run Times	3%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (3.68)

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
FACILITY CAPACITY EVALUATION

Facility Name & Location

Wailuku P. S.	Kahului Beach Rd. & Eluene St. Wailuku, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	3500	10	3.050	31%	8.81	88%		1	Field Test		2002
2002	3500	10	5.000	50%	18.61	186%	1.95		Calculation	111%	2003
2003	3500	10	3.110	31%	11.58	116%	-1.89	1	Flow Meters	-61%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (3.72)

COUNTY OF MA[illegible]
WASTEWATER RECLAMAT[illegible]IVISION
FACILITY CAPACITY EVA[illegible]TION

Facility Name & Location

Paia P. S.	Hana Hwy. & Puna Rd. Paia, Hi.

Year Evaluated	Capacity per Pump (gpm)	Pump Station Capacity (mgd)	ADWF Total Q (mgd)	% of Capacity ADWF	PWWF Total Q (mgd)	% of Capacity PWWF	Rise Total Q (mgd)	Flow Meter Code	Method of Flow Calculation	% Yearly Growth Rate	Next Evaluation Date
2001	590	0.855	0.182	21%	0.72	84%		2	Field Test		2002
2002	590	0.855	0.180	21%	0.67	78%	-0.00		Calculation	-8%	2003
2003	590	0.855	0.190	22%	0.71	83%	0.01		Pump Run Times	5%	2004
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

* Peak wet weather flow multiplier has been pre-determined by WWRD Administration during 2001 study. (3.74)

APPENDIX C

The Central Maui Wastewater Reclamation Facility Project:
Decision Matrix

Central Maui Wastewater Reclamation Facility Study: Evaluation Matrix 11/29/04

Evaluation Criteria / Alternatives	Cost							Environmental													Reclamation			Other				
	Operations and Maintenance Costs	Treatment Facilities Sunk Cost	Treatment Facilities New Cost	Wastewater Transmission Cost	Cost Impact to Taxpayers	Cost Impact to Sewer Rate Payers	Effluent Transmission Cost	Risk Impact of Operating Failure	Recovery from Catastrophic Failures	Provides for a Reliable Facility Operation	Compatibility Factors (Buffer Zone, Traffic)	Risk / Impact on Community and other facilities / infrastructure	Environmental Permit Requirements	Land Use Permit Requirements	Minimal Noise Impact	Minimal Visual Impact	Minimal Odor Impact / Potential	Environmental / Locational Factors (Corrosion Potential)	Minimal Shoreline Erosion Potential	Tsunami Zone / Flooding Potential	Dual water systems - potable/recycle water	Partnership with Landowners	Ability to expand to meet future capacity needs (land resources, compatbility, new technology)	Modular development - equipment / site expandability	Facility ability to incorporate new technology	Plant expandability/ Long term planning	Influent and effluent flow gravity feeds treatment plant / power generators (energy efficiency)	Plant Compliances - Reclamation Potential, Storm water regulation, WW Solids Handling, Composting
New Capacity Alternatives	3.3	3.3	3.7	3.5	3.8	3.7	3.4	4.2	4.1	4.1	3.6	3.7	3.1	2.9	3.0	3.3	4.0	3.6	3.8	4.0	2.7	3.1	3.8	3.6	3.9	3.9	3.1	3.7
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of injection wells for effluent disposal**.																												
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of brackish groundwater recharge for effluent disposal.**																												
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of ocean outfall for efffluent disposal.**																												
Expand existing Wailuku / Kahului WWRF for future capacity; strengthen WWRF for tsunami / erosion concerns. **Use of water recycling for effluent disposal.**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of injection wells for effluent**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of brackish groundwater recharge for effluent disposal.**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of ocean outfall for effluent disposal.**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Construct satellite WWRF(s) for future capacity. **Use of water recycling for effluent disposal.**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Develop smaller individual wastewater systems for future capacity. **Use of injection wells for effluent disposal.**																												
Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Develop smaller individual wastewater systems for future capacity. **Use of brackish groundwater recharge for effluent disposal.**																												
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Maintain existing Wailuku / Kahului WWRF; strengthen WWRF for tsunami / erosion. Develop smaller individual wastewater systems for future capacity. **Use of water recycling for effluent disposal.**																												
Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out exisitng Wailuku/Kahului WWRF. **Use of injection wells for effluent disposal.**																												
Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out exisitng Wailuku/Kahului WWRF. **Use of brackish groundwater recharge for effluent disposal.**																												
Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out exisitng Wailuku/Kahului WWRF. **Use of ocean outfall for effluent disposal.**																												
Construct new Central Maui WWRF to treat existing and future wastewater flows. Phase out exisitng Wailuku/Kahului WWRF. **Use water recycling for effluent disposal.**																												
Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of injection wells for effluent disposal.**																												
Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of brackish groundwater recharge for effluent disposal.**																												
Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of ocean outfall for effluent disposal.**																												
Build new WWRF for future flows and relocate existing Wailuku/Kahului WWRF away from tsunami and erosion zone. **Use of water recycling for effluent disposal.**																												
No Build / Do Nothing																												
Demand side Alternatives																												
Initiate water conservation / Produce less waste																												
Replace existing water fixtures																												
Reduce infiltration / inflow																												

Ranking Methodology:
Select one of the three scoring options
1 - Does not meet criteria objective
3 - Adequately meets criteria objective
5 - Fully meets critieria objective

APPENDIX D

Pair-wise Exercise Procedure

Central Maui Wastewater Reclamation Facility

Core Working Group Assignment

Pair-wise Comparison

At the Core Working Group meeting held on September 16, participants discussed a draft evaluation matrix. You received this matrix prior to the meeting either via email or postal mail. The evaluation matrix has two parts:

1. In the column on the left side are alternatives to meet Central Maui's wastewater needs. It includes both new-capacity alternatives and demand-side alternatives. These were developed in meetings 2 and 3.

2. Across the top of the matrix is a set of criteria. The criteria provide a way to weigh alternatives against each other so that the preferred alternative(s) can emerge in a systematically. These were developed in meeting 3.

This exercise is related to the criteria. The criteria are not all equal. They have different values for different people. We want to make sure that the criteria reflect community values so your input is crucial in this effort.

To make sure that the most important criteria have the higher values, we need to compare the criteria against each other.

Pair-wise comparison is a tool that compares criteria to each other in a systematic way. The criteria are listed horizontally and vertically. You will compare a horizontal criteria (A) to a vertical criteria (B), as follows:

If A is	much more important	than B, enter	5
	more important		4
	equal		3
	less important		2
	much less important		1

You only write in the unshaded boxes. The table will automatically adjust the shaded score to balance the score. For example, if A is much more important to you than B you enter a 5. This also means that B is much less important than A and its corresponding score in the shaded box will automatically be a 1. If you are writing in your scores, we will enter your input in a spreadsheet.

Each criteria will have a total that is the sum of all of the horizontal scores. We will add up all of the scores for final scores. The criteria with the highest scores will have the most weight in ranking the alternatives.

The Core Working Group is intentionally a diverse and balanced group that represents Central Maui. The criteria and their weight need to reflect your interests. Your participation will ensure the right balance. Please take the time to complete this exercise.

The deadline for your submitting your response is October 4.

To help you complete this form, we have set up a special session where a project team representative can assist you. The session is set for ___________________, from ____ to ___ at ________. You can also drop off your handwritten responses at that time. If you are emailing your responses, please send it to eplan1@aol.com. You may call ____ at ___ for more information.

APPENDIX C

TECHNICAL MEMORANDUM
CENTRAL MAUI WASTEWATER
EFFLUENT DISPOSAL OPTIONS

TECHNICAL MEMORANDUM

CENTRAL MAUI WASTEWATER EFFLUENT DISPOSAL OPTIONS

I. BACKGROUND

The purpose of this memorandum is to identify and evaluate the available effluent disposal options for the Central Maui Wastewater system. The disposal or effluent reuse options are critical to assessing viable facility locations and treatment unit process requirements. By understanding the alternative disposal methods, the proper site location and treatment process train can be implemented successfully.

The current effluent disposal practice used by the County of Maui at all of its wastewater reclamation facilities is either effluent injection wells or leach fields with R-1 water recycling. The County leaders made the decision during the construction of the original wastewater facilities in the 1970's to not construct deep ocean outfalls and instead construct wastewater treatment facilities that could promote water recycling.

II. GENERAL ASSUMPTIONS

Wastewater effluent disposal options or combination of options are varied and the selection is based on facility location, environmental concerns, regulatory issues and community beliefs. The options considered in this study included:

- Injection wells
- Deep ocean outfall
- Groundwater recharge
- Water Recycling

Of these four options injection wells and deep ocean outfall are true effluent disposal options. The use of groundwater recharge and water recycling are options that promote the reuse of the effluent as a water resource and would require an alternative effluent disposal method to provide the required disposal redundancy. DOH regulates and approves the application of any of these options.

The applicable DOH regulations and guidelines that are used to manage the review, approval and operations oversight process include:

- GUIDELINES FOR THE TREATMENT AND USE OF RECYCLED WATER Hawaii State Department of Health Wastewater Branch, May 15, 2002 (Water recycling/Groundwater recharge)

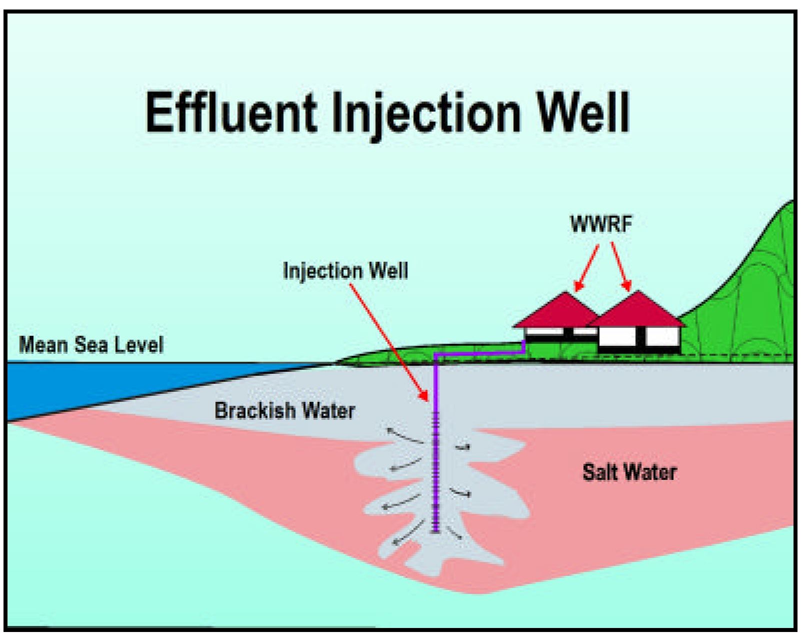
- Hawaii Administrative Rules – Title 11-23 Underground Injection Control (Injection Wells)
- Hawaii Administrative Rules – Title 11-54 Water Quality Standards (Deep ocean outfall)
- Hawaii Administrative Rules – Title 11-55 Water Pollution Control and NPDES General permits (Deep ocean outfall)
- Hawaii Administrative Rules – Title 11-62 Wastewater Systems (Effluent Disposal/Effluent Reuse)

III. EFFLUENT DISPOSAL OPTIONS

A. Injection Wells

Injection wells are bored and cased holes, extending to depths usually below mean sea level into a soil layer that has a high permeability to disperse the treated effluent into the receiving ground water. Figure 1 presents a typical installation of an injection well. Well size is determined by the amount of flow conveyed, frequency of well use, recovery period of the wells, and the dilution / dispersion rate within the water tables. Effluent discharged into the wells disperses within the brackish water and salt water tables.

Figure 1 – Typical Injection Well Installation



One of the challenges with operating injection wells is developing an effective cleaning procedure to maintain its permeability. Many wells in Hawaii have failed because of the discharge of poor quality effluent into the well and inadequate cleaning methods and frequency. The necessity for a high quality effluent is a very important consideration in deciding to use injection wells as the primary means of effluent disposal.

Cleaning of injection wells is a combination of art and science. The available cleaning methods (pumping, airlifts, dry ice, baling, etc) must be considered in locating an injection well to increase the chances of operating a reliable injection well system.

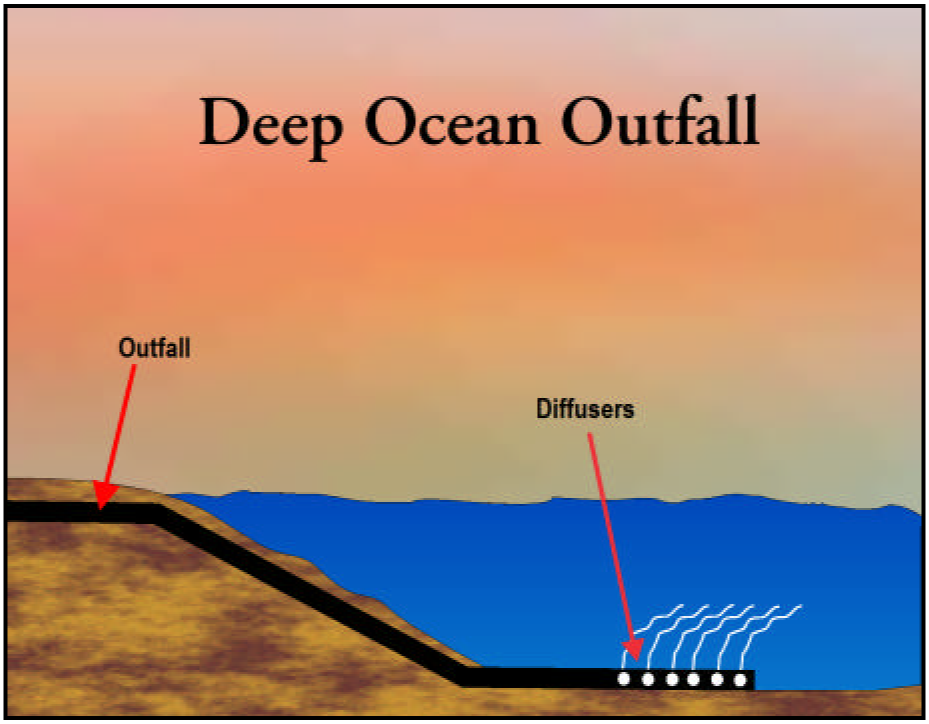
The major regulatory requirements and considerations for siting and constructing effluent injection wells include:

- The well must be located below the DOH defined Underground Injection Control (UIC) line
- DOH UIC permit is required
- Potential for a EPA UIC permit requirement
- Impact on adjoining water resources quality
- Community concerns

B. Deep Ocean Outfall

A deep ocean outfall consists of laying a pipe from the wastewater treatment facility that extends into deep ocean water offshore. Figure 2 presents the concept of a deep ocean outfall. The length of the outfall into the ocean is determined by such factors as the prevailing ocean currents, dilution rate, ocean temperature, wastewater effluent characteristics, and construction costs.

Figure 2 – Deep Ocean Outfall



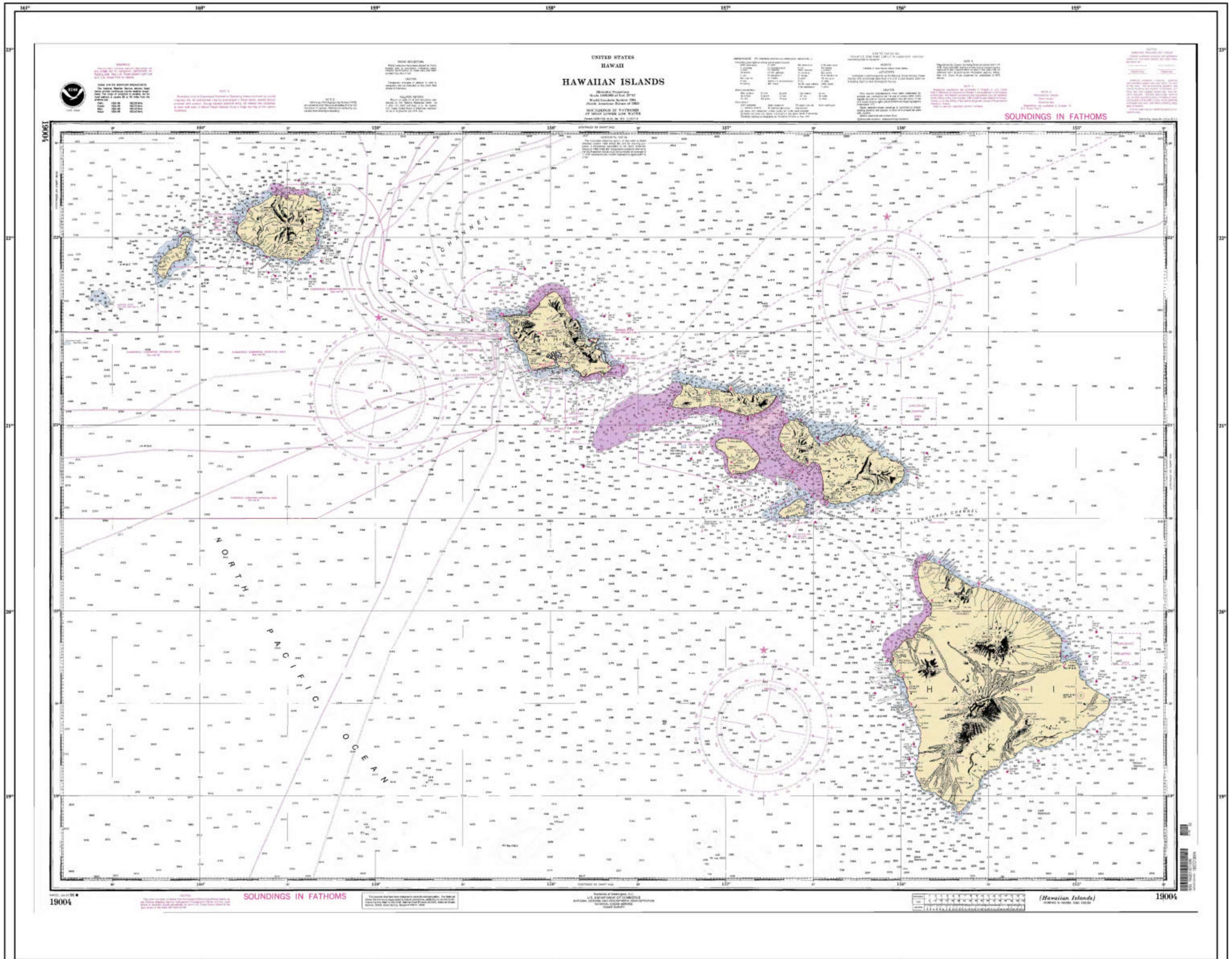
It should be noted that ocean outfalls cannot be constructed within a Humpback Whale Sanctuary Zone. Figure 3 presents the Humpback Whale Sanctuary Zone around Maui County. As Figure 3 shows, the Wailuku-Kahului Region appears to be out of this zone.

Although allowed by regulations to consider a deep ocean outfall for effluent disposal, the probability of constructing a deep ocean outfall is highly unlikely for Maui County. The potential detrimental impact of the ocean floor during construction, construction costs and negative community sentiment does not support a deep ocean outfall. The one benefit of a deep ocean outfall is a high quality effluent (greater than secondary treatment) is potentially not required because of the size of the diffusers and discharge to the open ocean.

The major regulatory requirements and considerations for locating and constructing a deep ocean outfall include:

- NPDES Permit
- Environmental Impact Statement (EIS)
- Community acceptance
- Long term continuous ocean monitoring

Figure 3 - Humpback Whale Sanctuary Zone



C. Groundwater Recharge

Groundwater recharge requires large open space and soil characteristics that have high transmissivity rates to support percolation into the groundwater aquifer. Maximum percolation rates determine the land area requirements. For example, full tests of groundwater recharge done on the island of Oahu were able to discharge at a loading of about 70,000 gallons per acre per day.

The area chosen for the recharge should be located to provide maximum influence on existing wells. The area southwest of the Maui Lani Development may be the most appropriate. According to the U.S. Geological Survey Report, the groundwater moves in a northeast direction from that area.

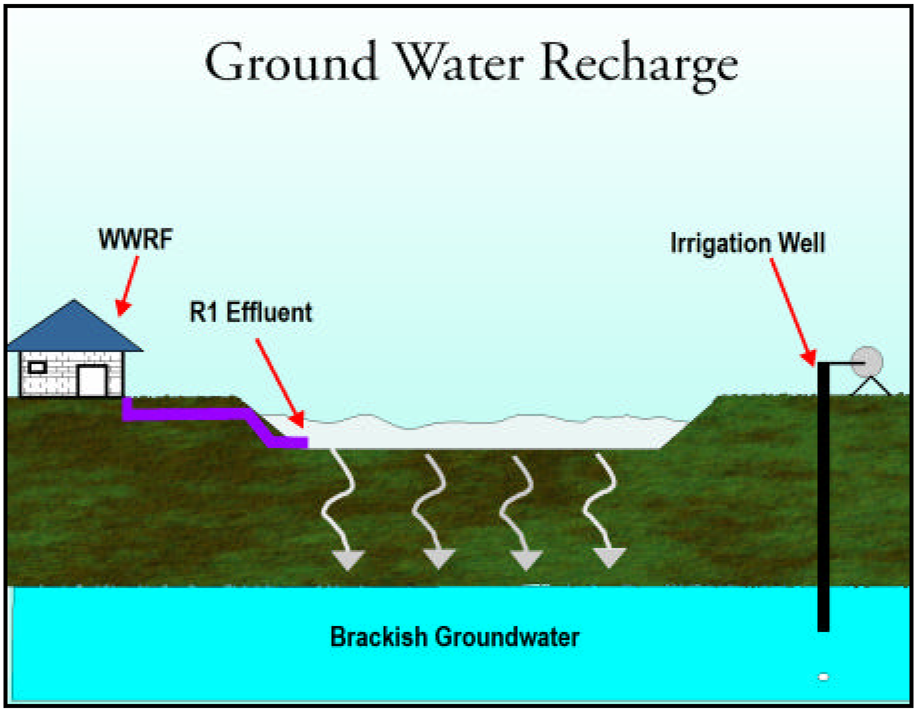
This concept would be used in regions where the groundwater is brackish and withdrawn for irrigation. Groundwater recharge would not be applied over a potable water aquifer. Figure 4 presents a schematic of a groundwater recharge system. The effluent is discharged into a holding pond or spreading basin where it is allowed to percolate into the soil, experiencing a natural filtration phase as the water moves through several sediment layers. Water disperses within the brackish groundwater table.

The consideration of groundwater recharge for the Central Maui region is based on the current practice of withdrawing brackish groundwater for irrigation of open space in the Wailuku/Kahului region. R-1 quality effluent would be processed for this application. The implementation of this option for effluent disposal will require a secondary method (injection wells, deep ocean outfall) for effluent disposal.

The major regulatory requirements and considerations for siting and constructing a deep ocean outfall include:

- Compliance with DOH Water Reuse Guidelines
- Compliance with HAR 11-62
- Potential requirement for EIS
- Potential requirement for UIC permits (EPA and DOH)
- Limited to area below the UIC line
- Provision for secondary effluent disposal method

Figure 4 – Ground Water Recharge



D. Water Recycling

Water recycling promotes the reuse of a valuable water resource for appropriate applications. Water recycling is not a new concept and has been practiced successfully throughout the world for more than 50 years. This practice preserves the potable water supply for higher level uses than irrigation or industrial uses.

Implementation of a successful water recycling program requires a driver. Typically the driver could be either the need for additional water resources to support economic growth for a region or the need to develop an alternative effluent disposal option. Maui County has completed a Water Reuse Study for Central Maui in June 1991 that concludes there are potential water reuse sites in Central Maui. These applications are primarily for open space irrigation. The one challenge noted was these sites having their own irrigation well, making potential reuse water rates an issue. Outside of the existing potential sites the development growth in Central Maui provides great opportunities to further develop the County's water recycling program in the region.

The major regulatory requirements and considerations for implementing a water recycling program include:

- Compliance with DOH Water Reuse Guidelines
- Compliance with HAR 11-62
- Community acceptance/outreach
- Provision of secondary effluent disposal method

APPENDIX D

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY WASTEWATER CAPACITY DEMAND ALTERNATIVES

ALTERNATIVE No 1

Alternative Description

- Expand existing Wailuku/Kahului WWRF to treat future flows
- Fortify WWRF to withstand 100 year tsunami
- Reinforce shoreline to mitigate shoreline erosion
- Effluent quality - R-2 effluent
- Effluent disposal - Injection wells
- WWRF requires effluent filters

Water Recycling Opportunities

- Onsite irrigation

Site Options

- Maintain existing WWRF site

Community Impacts

- Potential for shoreline degradation
- Potential for catastrophic system failure from tsunami

Permit Requirements

- CDUA
- SMA
- UIC Permit
- Shoreline Variance (Shoreline armoring)
- Environmental Assessment or Environmental Impact Statement

Cost Impacts

- Capital - $$
- O&M - $$
- Sunk -

Service Area

- Central Maui Region

ALTERNATIVE No 2

Alternative Description

- Construct new regional Central Maui WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami-proof WWPS at existing WWRF site
- Effluent quality – R-1 effluent
- Effluent disposal – Brackish groundwater recharge
- Requires redundant disposal
- Major upgrade of wastewater collection system

Water Recycling Opportunities

- Groundwater recharge
- Onsite WWRF irrigation
- Open space irrigation from groundwater draw

Site Options

- Old Puunene Airport
- Adjacent to Puunene Sugar Mill
- South of Kuihelani Highway
- South of Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact – major capital expenditure
- Increased potential for odor discharges

Permit Requirements

- Environmental Impact Statement
- UIC Permit (Potential)
- Large land area requirement for groundwater recharge
- Rezoning
- Community Plan Revision

Cost Impacts	Service Area
• Capital - $$$$ • O&M - $$ • Sunk - <$>	• Central Maui Region • Maalaea • North Kihei

ALTERNATIVE No 3

Alternative Description

- Construct new regional Central Maui WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami-proof WWPS at existing WWRF
- Effluent quality – R-1 effluent
- Effluent disposal – Water Recycling
- Requires redundant disposal
- Major upgrade of wastewater collection system

Water Recycling Opportunities

- Onsite WWRF irrigation
- Agriculture irrigation
- Industrial reuse
- Open space irrigation
- Golf course irrigation

Site Options

- Old Puunene Airport
- Adjacent to Puunene Sugar Mill
- South of Kuihelani Highway
- South of Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact – major capital expenditure
- Increased potential for odor discharges

Permit Requirements

- Environmental Impact Statement
- UIC Permit
- Rezoning
- Community Plan revision

Cost Impacts

- Capital - $$$$
- O&M - $$$
- Sunk - <$>

Service Area

- Central Maui Region
- Maalaea
- North Kihei

ALTERNATIVE No 4

Alternative Description

- Construct new regional Central Maui WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami-proof WWPS at existing WWRF
- Effluent quality – R-2 effluent
- Effluent disposal – Injection wells
- WWRF requires effluent filters

Water Recycling Opportunities

- Groundwater recharge
- Onsite WWRF irrigation

Site Options

- Old Puunene Airport
- Adjacent to Puunene Sugar Mill
- South of Kuihelani Highway
- South of Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact caused by major capital expenditure
- Increased potential for odor discharges

Permit Requirements

- Environmental Impact Statement
- UIC Permit
- Rezoning
- Community Plan Revision

Cost Impacts

- Capital - $$$$
- O&M - $$
- Sunk - <$>

Service Area

- Central Maui Region
- Maalaea
- North Kihei

ALTERNATIVE No 5

Alternative Description

- Construct new Central Maui WWRF for future wastewater flows
- Relocate Wailuku/Kahului WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami-proof WWPS at existing WWRF
- Effluent quality – R-1 effluent
- Effluent disposal – Brackish groundwater recharge
- Redundant effluent disposal required
- Major upgrade of wastewater collection system

Water Recycling Opportunities

- Groundwater recharge
- Onsite WWRF irrigation

Site Options

- South of Airport
- South of Kuihelani Highway
- Adjacent to Puunene Sugar Mill
- Old Puunene Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact - major capital expenditure
- Requires large land area

Permit Requirements

- Environmental Impact Statement
- UIC Permit (Potential)
- Rezoning
- Community Plan Revision

Cost Impact

- Capital - $$$$$
- O&M - $$$
- Sunk - <$>

Service Area

- Central Maui
- North Kihei
- Maalaea

ALTERNATIVE No 6

Alternative Description

- Construct new Central Maui WWRF for future wastewater flows
- Relocate Wailuku/Kahului WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami -proof WWPS at existing WWRF
- Effluent quality – R-1 effluent
- Effluent disposal – Water Recycling
- Redundant effluent disposal required
- Major upgrade of wastewater collection system

Water Recycling Opportunities

- Groundwater recharge
- Onsite WWRF irrigation

Site Options

- South of Airport
- South of Kuihelani Highway
- Adjacent to Puunene Sugar Mill
- Old Puunene Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact - major capital expenditure
- Requires large land area

Permit Requirements

- Environmental Impact Statement
- UIC Permit (Potential)
- Rezoning
- Community Plan Revision

Cost Impact

- Capital - $$$$
- O&M - $$$
- Sunk - <$>

Service Area

- Central Maui
- North Kihei
- Maalaea

ALTERNATIVE No 7

Alternative Description

- Expand existing Wailuku/Kahului WWRF to treat future flows
- Fortify WWRF to withstand 100 year tsunami
- Reinforce shoreline to mitigate shoreline erosion
- Effluent quality - R-1 effluent
- Effluent disposal – Brackish groundwater recharge
- Redundant effluent disposal required
- Large land area required for groundwater recharge

Water Recycling Opportunities

- Onsite irrigation

Site Options

- Existing WWRF site
- South of Kuihelani highway for groundwater recharge

Community Impacts

- Potential for shoreline degradation
- Potential for catastrophic system failure caused by tsunami

Permit Requirements

- CDUA
- SMA
- UIC Permit
- Shoreline Variance (Shoreline armoring)
- Environmental Assessment or Environmental Impact Statement

Cost Impacts

- Capital - $$$
- O&M - $$$
- Sunk - <$>

Service Area

- Central Maui Region

ALTERNATIVE No 8

Alternative Description

- Construct new regional Central Maui WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami proof WWPS at existing WWRF
- Effluent quality – R-2 effluent
- Effluent disposal – Ocean outfall

Water Recycling Opportunities

- Onsite WWRF irrigation

Site Options

- Adjacent to Puunene Sugar Mill
- South of Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact - major capital expenditure

Permit Requirements

- Environmental Impact Statement
- UIC Permit
- Rezoning
- Community Plan revision

Cost Impacts

- Capital - $$$$
- O&M - $$
- Sunk - <$>

Service Area

- Central Maui Region

ALTERNATIVE No 9

Alternative Description

- Expand existing Wailuku/Kahului WWRF to treat future flows
- Fortify WWRF to withstand 100 year tsunami
- Reinforce shoreline to mitigate shoreline erosion
- Effluent quality – R-2 effluent
- Effluent disposal – Ocean outfall

Water Recycling Opportunities

- Onsite irrigation

Site Options

- Existing WWRF site

Community Impacts

- Potential for shoreline degradation
- Potential for catastrophic system failure from tsunami

Permit Requirements

- CDUA
- SMA
- UIC Permit
- Shoreline Variance (Shoreline armoring)
- Environmental Assessment or Environmental Impact Statement

Cost Impacts

- Capital - $$
- O&M - $$
- Sunk -

Service Area

- Central Maui Region

ALTERNATIVE No 10

Alternative Description

- Construct new Central Maui WWRF for future wastewater flows
- Relocate Wailuku/Kahului WWRF
- Phase out existing Wailuku/Kahului WWRF
- Construct tsunami -proof WWPS at existing WWRF
- Effluent quality – R-2 effluent
- Effluent disposal – Injection wells
- WWRF requires effluent filters

Water Recycling Opportunities

- Groundwater recharge
- Onsite WWRF irrigation

Site Options

- South of Airport
- South of Kuihelani Highway
- Adjacent to Puunene Sugar Mill
- Old Puunene Airport

Community Impacts

- Extension of Kanaha Beach Park
- Reduced potential for catastrophic system failure
- Financial impact - major capital expenditure

Permit Requirements

- Environmental Impact Statement
- UIC Permit
- Rezoning
- Community Plan Revision

Cost Impact

- Capital - $$$$$
- O&M - $$$
- Sunk - <$>

Service Area

- Central Maui
- North Kihei
- Maalaea

ALTERNATIVE No 14

Alternative Description

- Expand existing Wailuku/Kahului WWRF to treat future flows
- Fortify WWRF to withstand 100 year tsunami
- Reinforce shoreline to mitigate shoreline erosion
- Effluent quality – R-1effluent
- Effluent disposal – Water Recycling

Water Recycling Opportunities

- Onsite WWRF irrigation
- Agriculture irrigation
- Industrial reuse
- Open space irrigation
- Golf course irrigation

Site Options

- Existing WWRF site

Community Impacts

- Potential for shoreline degradation
- Potential for catastrophic system failure from tsunami
- Preserve potable water resources

Permit Requirements

- CDUA
- SMA
- Shoreline Variance (Shoreline armo ring)
- Environmental Assessment or Environmental Impact Statement

Cost Impact

- Capital - $$$
- O&M - $$
- Sunk -

Service Area

- Central Maui Region

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS ● SURVEYORS

APPENDIX E

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY SHORELINE EVALUATION REPORT

Central Maui Wastewater Reclamation Facility

DRAFT

Shoreline Evaluation Report

Prepared for:

Austin, Tsutsumi & Associates, Inc.
501 Sumner Street, Suite 521
Honolulu, HI 96817

Prepared by:

Moffatt & Nichol
250 W. Wardlow Road
Long Beach, CA 90807

April 2005

M&N File: 5454

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

DRAFT

SHORELINE EVALUATION REPORT

I. INTRODUCTION

A. Background

The County of Maui owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF). The facility has a design capacity of 7.9 million gallons per day (MGD) and it is estimated the facility will reach this capacity sometime in the future. The County will soon be making decisions on how the wastewater treatment needs can be met for the next 20 to 30 years. Alternatives need to be discussed which will provide for the future wastewater treatment needs of the County. Alternatives under consideration include relocating the facility, increasing the capacity of the current facility, or directing some of the future flows to another facility or facilities.

A critical constraint associated with the alternatives analysis is that many of the County's beaches are eroding, including the shoreline fronting the Kahului WWRF. There are concerns regarding the current erosional trends on the existing and any future plant expansions.

The Wailuku Wastewater Pump Station (WWPS) is also part of the County's wastewater collection system. This pump station is also located close to the shoreline, on the west side of Kahului Harbor. This shoreline has experienced historical shoreline recession and needs to be included in the shoreline evaluation.

B. Purpose and Scope

The purpose of this study is to quantify shoreline erosion trends, assess potential causes for erosion, and develop preliminary shoreline protection alternatives for the Kahului WWRF site and also at the WWPS. The study is based on existing and available data and studies relating to shoreline erosion, causes of erosion, and potential solutions.

The shoreline evaluation comprises the following tasks:

1. Quantify shoreline erosion;

2. Assess potential causes of erosion;

3. Develop solution alternatives; and

4. Concept development.

II. RELEVANT COASTAL PROCESSES AND CONDITIONS

Understanding the relevant coastal processes and conditions is important in assessing causes for erosion and shoreline change and also for assessing potential solutions for shoreline protection. This section outlines water levels, wave conditions, and climate conditions (wind and precipitation).

A. Water Levels

Tides in the Hawaiian Islands are semi-diurnal, with two high waters and two low waters each tidal day. The tidal range varies from tide to tide, thus the tides are considered to have a diurnal inequality. The mean tide range is approximately two feet, and the maximum annual tide range is approximately four feet. Tide data for Kahului Harbor is presented in Table 1 [1].

Table 1. Kahului Harbor Tidal Datums

Highest Observed Water Level (1/9/74)	3.70 feet
Mean Higher High Water (MHHW)	2.35 feet
Mean High Water (MHW)	1.97 feet
Mean Sea Level (MSL)	1.17 feet
Mean Tide Level (MTL)	1.16 feet
Hawaiian Geodetic Vertical Datum (HGVD)	0.90 feet
Mean Low Water (MLW)	0.35 feet
Mean Lower Low Water (MLLW)	0.00 feet
Lowest Observed Water Level (6/20/55)	-1.40 feet

In addition to normal short-term periodic fluctuations of the sea surface, there is also a progressive change in sea level. Various projections of future sea level rise resulting from global warming, given past and projected increases in atmospheric carbon dioxide and other “greenhouse” gases have been developed. There can also be a relative sea level rise that results from combinations of rising sea level and sinking land. This can be of particular importance in the Hawaiian Islands due to ongoing geologic and tectonic processes. Relative sea level rise measured at Kahului Harbor is approximately 1.2 inches per decade (University of Hawaii 1998).

B. Waves

Ocean waves are the critical driving force in the movement of beach sand along a shoreline. This section provides a brief summary of the wave climate along Maui’s North coast.

[1] Obtained from <<http://co-ops.nos.noaa.gov/benchmarks/1615680.html>>

1. Wave Sources

Waves approaching the Hawaiian Islands may be represented by the following general types:

1. ***Northeast Trade Waves*** – These waves are generated by the northeasterly trade winds that prevail approximately 75 percent of the year. Northeast trade waves are characterized in deep water by wave heights of up to 20 feet and periods ranging from 5 to 12 seconds. They occur most frequently and are the largest during the months from April through November.

2. ***Kona Storm Waves*** **–** During the winter season, Kona winds generate waves from the southwest with characteristics similar to those of trade waves. Kona conditions occur most frequently from November through April. Infrequently, a Kona storm associated with a large low-pressure system generates large storm waves from the southwest.

3. ***North Pacific Swell*** **–** The North Pacific swell, for which the large surf on the north and northwest coasts of Hawaii has become famous, is due to the waves generated from North Pacific extra-tropical cyclones. These large waves have heights in excess of 20 feet and periods ranging from 10 to 15 seconds. The North Pacific cyclones travel eastward and generate waves that approach the northwestern exposed shores of the islands. These waves are most likely to occur from October through April.

4. ***Southern Hemisphere Swell*** **–** Southern hemisphere swell that can reach the Hawaiian Islands is generated in the South Pacific Ocean. Large, extra-tropical storms generate waves and swell that travel 5,000 miles with breaking wave heights ranging up to 10 to 15 feet annually. The wave heights in deep water are 3 to 6 feet, with 14 to 18 second periods. These waves are generally characterized by rather long wave lengths, distinct wave groups, and are independent of the local wind system.

5. ***Local Storms and Hurricanes*** – Local storms and hurricanes are infrequent. Tropical storms generated off the coast of Mexico move westward through the equatorial region and occasionally deflect northward toward the Hawaiian Islands. Hurricane Iniki in September 1992, Hurricane Iwa in November 1982, Hurricane Dot in August 1959, and Hurricane Nina in December 1957 are the major hurricanes that have caused damage to the Hawaiian shoreline in the past 40 years.

2. Wave Exposure at Maui's North Coast

The Wailuku-Kahului Wastewater Reclamation Facility and Wailuku Wastewater Pump Station are located on Maui's North Central Coast, adjacent to Kahului Harbor. The North Central Coast is exposed to Northeast trade waves and North Pacific swell. The Northeast trade waves approach the Kahului area from the Northeast and the North Pacific swell approach from the North to Northwest.

C. Wind

The predominant winds in the vicinity of the Hawaiian Islands are the northeast trade winds, which are present approximately 70% to 75% of the year. The other 25% to 30% of the year produces Kona Winds predominantly from the south to southwest. Trade winds generally range from 10 to 25 mph, although can reach 40 to 50 mph during extreme events (Fletcher et al. 2002). On Maui, the trade winds are strongly influenced by topographic conditions. For example, at Maalaea and Kihei the wind speeds may be higher than the north shore due to the trade winds accelerating across the island's isthmus. At the Kahului site, the Northeast trade wind direction is unaffected by the island topography, and is clearly from the unobstructed prevailing northeast direction.

Winter is characterized by a weakening of the northeast trade winds (Moberly and Chamberlain 1964) and the appearance of southwesterly winds, known as Kona winds. The Kona winds are characterized by light and variable winds that persist for a few days to a few weeks at a time. Although Kona storms are capable of generating wind speeds exceeding 30 knots, the frequency of occurrence is low.

D. Precipitation

The average monthly precipitation at Kahului is presented in the table below. The average annual total is estimated to be approximately 19 inches per year (Western Regional Climate Center website at <<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?hikahu>>).

Table 2. Average Monthly Rainfall at Kahului

Average Rainfall at Kahului, Maui from 4/1/1954 to 3/31/2004 (in inches)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
3.73	2.59	2.55	1.44	0.67	0.24	0.48	0.48	0.36	1.05	2.37	3.13	19.08

E. Typical Hawaiian Beach Characteristics

The following provides a general description of Hawaiian beaches including their formation and composition. Most of the information was derived from the study *Hawaiian Beach Systems* by Moberly and Chamberlain (1964), unless otherwise noted.

Each of the Hawaiian Islands was formed by volcanoes that built up basaltic lava in intermittent layers from the seafloor. The general succession of island formation has been from northwest down the island chain to the southeast, with Maui being one of the more recent geologic formations. Maui was formed by the two adjacent volcanoes of Haleakala and West Maui, with an isthmus connecting the two. Kahului is located on the north side of Maui.

Coral reefs are found along much of the Hawaiian Island shorelines. These wave-resistant structures are formed by shallow water organisms in warm water environments. The most common type of reefs found in Hawaiian waters is fringing reefs. Fringing reefs along the sheltered leeward coasts in Hawaii are some of the wider and flatter reefs in the islands. Commonly, they have detrital (originating from the land after weathering and erosion) grains mixed with the predominantly calcareous sands covering them and their adjacent beaches. These reefs were the ones most utilized by the ancient Hawaiians for their fish ponds.

Hawaiian beaches mainly consist of medium grain-size sand, although their sediments actually range from gravel to sandy mud. Many beaches have coarse sand; most Maui beaches have fine sand. Hawaiian beach sand is composed of two general types of grains mixed together in proportions that vary from one locality to another. Light-colored calcareous grains of biochemical origin, the fragments of skeletal parts of certain marine invertebrate animals and algae, contrast with dark-colored silicate grains of detrital origin.

III. SITE DESCRIPTION

A site visit was conducted on July 16, 2004, to the WWRF and the WWPS. Appendix A contains photographs from the site visit. This section describes each site and existing conditions, uses, and features.

A. Kahului-Wailuku WWRF

The Kahului-Wailuku WWRF is located on the north shore of the island of Maui, and approximately one mile east of the Kahului Harbor. Figure 1 is an aerial photograph of the site. The area immediately west of the WWRF is considered to be a heavy industrial area and includes oil tank farms, auto storage yards, warehouses, and a power plant (Brown and Caldwell 1990). The port facilities at Kahului Harbor are located approximately ½ mile to the west of the WWRF. The Kahului Airport is located approximately one mile east of the

WWRF and Kanaha Beach Park is located approximately ¾ mile to the east of the WWRF.

The WWRF site is bounded on the north by approximately 1350 linear feet of shoreline in Kahului Bay. There is a 520-foot existing rock revetment along this shoreline that was constructed between 1977 and 1978 fronting the WWRF retention pond (Makai Ocean Engineering and Sea Engineering 1991). Observations during the site visit on July 16, 2004, indicated that the east flank of the revetment is being outflanked from recent erosion trends in the area (see Figure 2 and Figure 3).

The shoreline along this reach has experienced severe erosion as can be seen by the remnants of an old WWII pill box offshore of the beach (Figure 4). Also, there are a series of old groins east of the plant that were constructed during WWII to retard the erosion process (USEPA 1974).

The 13,000-foot long beach that extends east from Kahului Harbor is also known as Sprecklesville Beach. This reach is broken into a series of pocket beaches separated by manmade groins and natural beachrock and lava points (Moberly 1963 and USACE 1971). The beach sand is poorly sorted calcareous sand, ranging in size from medium-sized grains to cobbles. The beaches along this reach are backed by large sand dunes. The Sprecklesville Beach area is primarily used by locals and visitors for world-class kite surfing and windsurfing, as well as fishing and regular beach recreation.

There is a large fringe reef just offshore that extends for several miles along this reach. The reef is characterized by a wide crest (one-half to one mile in width) that extends from a shallow nearshore toe to depths ranging from 10 to 30 feet (Cox 1954). Closer to the Kahului Harbor, the reef is narrow or absent (Cox 1954).

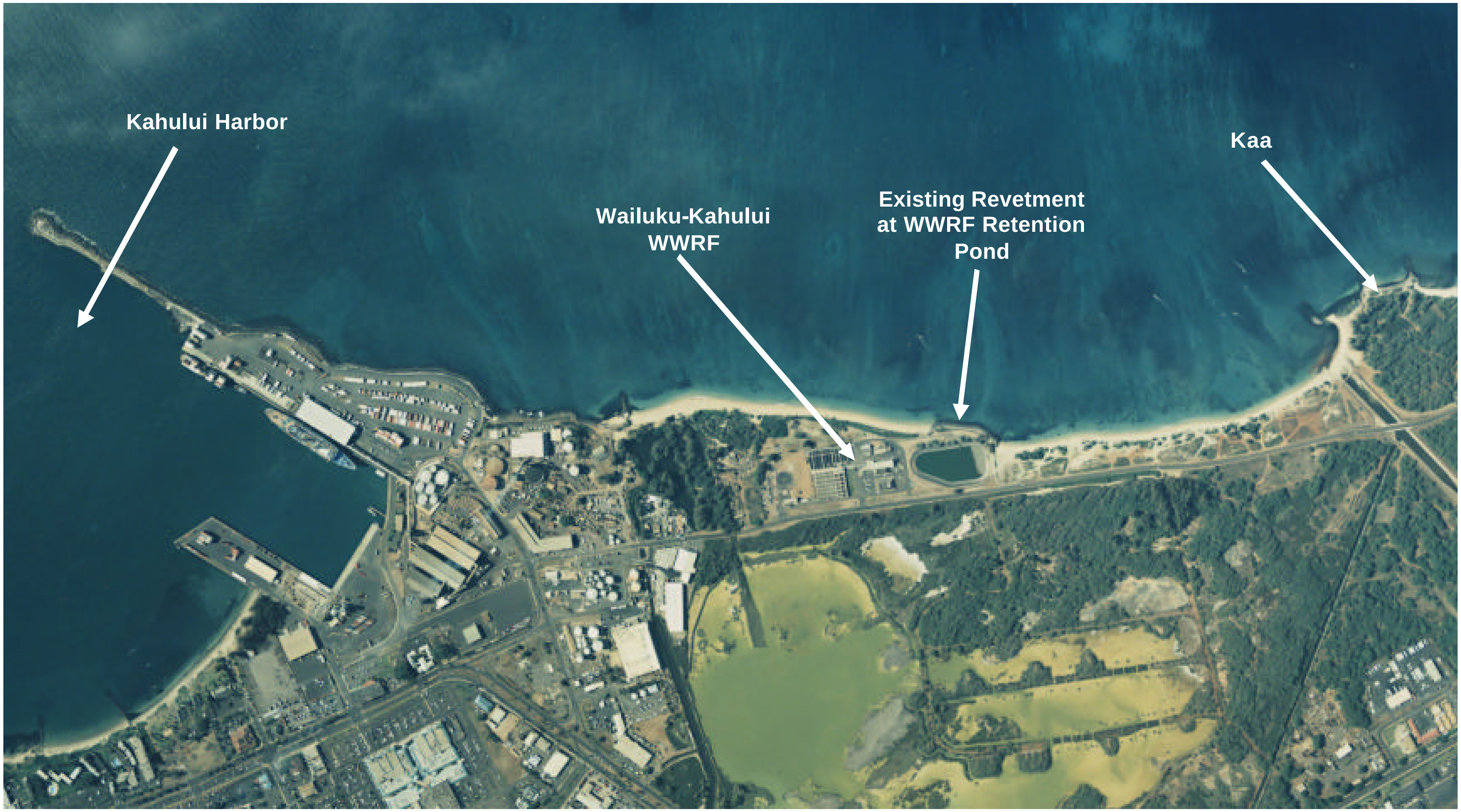


Figure 1. Aerial photograph of the coast from Kahului Harbor to Kaa
[obtained from <<http://www. soest.hawaii.edu/coasts/Islandimagery.html>>]

Figure 2. East flank of the revetment fronting the Wailuku-Kahului WWRF.

Figure 3. Looking West towards the Wailuku-Kahului WWRF revetment.

Figure 4. Looking East from the revetment at the Wailuku-Kahului WWRF. (Notice the old "pill box" offshore.)

B. Wailuku Wastewater Pump Station

The shoreline along the coast west of the Kahului Harbor is characterized as a narrow beach of poorly sorted sand and gravel (USACE 1971). Figure 5 is an aerial photograph of the Wailuku WWPS site. The Waihee Reef extends from Waihee Point to Kahului Harbor. The width of this reef near the harbor is about 500 feet wide.

The Wailuku Wastewater Pump Station is located west of the Kahului Harbor. Observations during the site visit on July 16, 2004, indicated a rocky shoreline, which consisted of natural cobbles and boulders, and also concrete rubble and armor stone. The rocky slope did not appear to be unstable or erodible. However, there is upland erosion on the site appearing to be from high water levels and storm waves reaching higher elevations on the beach slope, causing the upland soil to erode, leaving a high vertical escarpment. This escarpment can be seen in Figure 6 and Figure 7. Verbal communication with County staff (Dave Taylor, July 16, 2004) indicated that a large storm in 1993 caused over 10 feet of horizontal upper bank loss in one day. In early February 1993, 25 to 30-foot waves were recorded on the North Shore of Maui (Fletcher et al. 2002)

Also, the shoreline along this reach does not appear to be generally used by the public for beach access and/or recreation. North of the site, it appears the residential area is highly armored with vertical seawalls (Figure 7).

Figure 5. Aerial photograph of the coast at the Wailuku Wastewater Pump Station.
[obtained from <<http://www. soest.hawaii.edu/coasts/Isla ndimagery.html>>]

Figure 6. Large escarpment fronting the WWPS property (fence).

Figure 7. Escarpment and shoreline looking northwest from WWPS.
(notice large seawall fronting property to the north.)

IV. WAILUKU-KAHULUI WWRF SHORELINE CHANGES

A. Long-Term Changes

This section discusses long-term shoreline changes over the last 50 to 100 years. The shoreline reach that is discussed is a 13,000-foot long reach extending from Kahului Harbor. It is broken into a series of pocket beaches by manmade groins and natural lava and beachrock points.

Shoreline erosion in the vicinity of the Kahului WWRF has been documented for over 100 years. Doak Cox (1954) stated the shoreline between Kahului and Paia had been eroding for at least 50 years, since soon after the turn of the last century. Cox stated the only portion of the shoreline that was not eroding was the area east of the Kahului East breakwater where the beach had been accreting over a length of 2,400 feet. This accretion resulted from the construction of the Kahului Harbor breakwaters and the longshore transport of sediment flow from east to west. Cox's 1954 report does indicate this area adjacent to the east breakwater was recently receding.

Other reports which outline early erosional trends along the project area include a report by Moberly (1963), which states that "lines of beachrock awash at the waterline as much as 800 feet offshore show the historical record of erosion is merely the latest stage in a process operating over the last few hundred years." In the report, Moberly indicates sand mining was being conducted along the western end of the 5-mile long section of beach that extends east from the Kahului Harbor. He states this causes changes in the beach configuration because of the mining and stockpiling operations. Another report by the US Army Corp of Engineers and the State of Hawaii (1964) describes the beach as having "moderate to minor erosion in recent years."

These studies are also complimented by the County of Maui Shoreline Erosion Maps. These maps were compiled using aerial photography and historic T-sheets to determine long-term historic trends in shoreline position. The earliest shoreline position on the County Maps is the 1899 shoreline, followed by 1912, 1929, 1960, 1975, 1987, 1988, 1997, and 2002. The long-term shoreline erosion rate for the section of coast from Hobron Point to Kaa is indicated in Figure 8. The red bars indicate the Annual Erosion Hazard Rate (AEHR) in feet per year (ft/yr). At the western end of the map, the AEHR ranges from -0.5 ft/yr to almost -3.0 ft/yr. From the western edge of the WWRF property line, the AEHR increases gradually from near 0.0 ft/yr to slightly over -4.0 ft/yr at the eastern terminus of the map. Directly fronting the WWRF, the historic long-term AEHR is shown to be between -1.0 and -2.5 ft/yr. It is noted however, that once a section of coast is armored, the long-term shoreline erosion rate only consists of the pre-armored time frame. This may represent a skewed view of the erosion rate fronting the WWRF revetment, because the structure itself halts further shoreline retreat and therefore decreases the erosion rate over time.

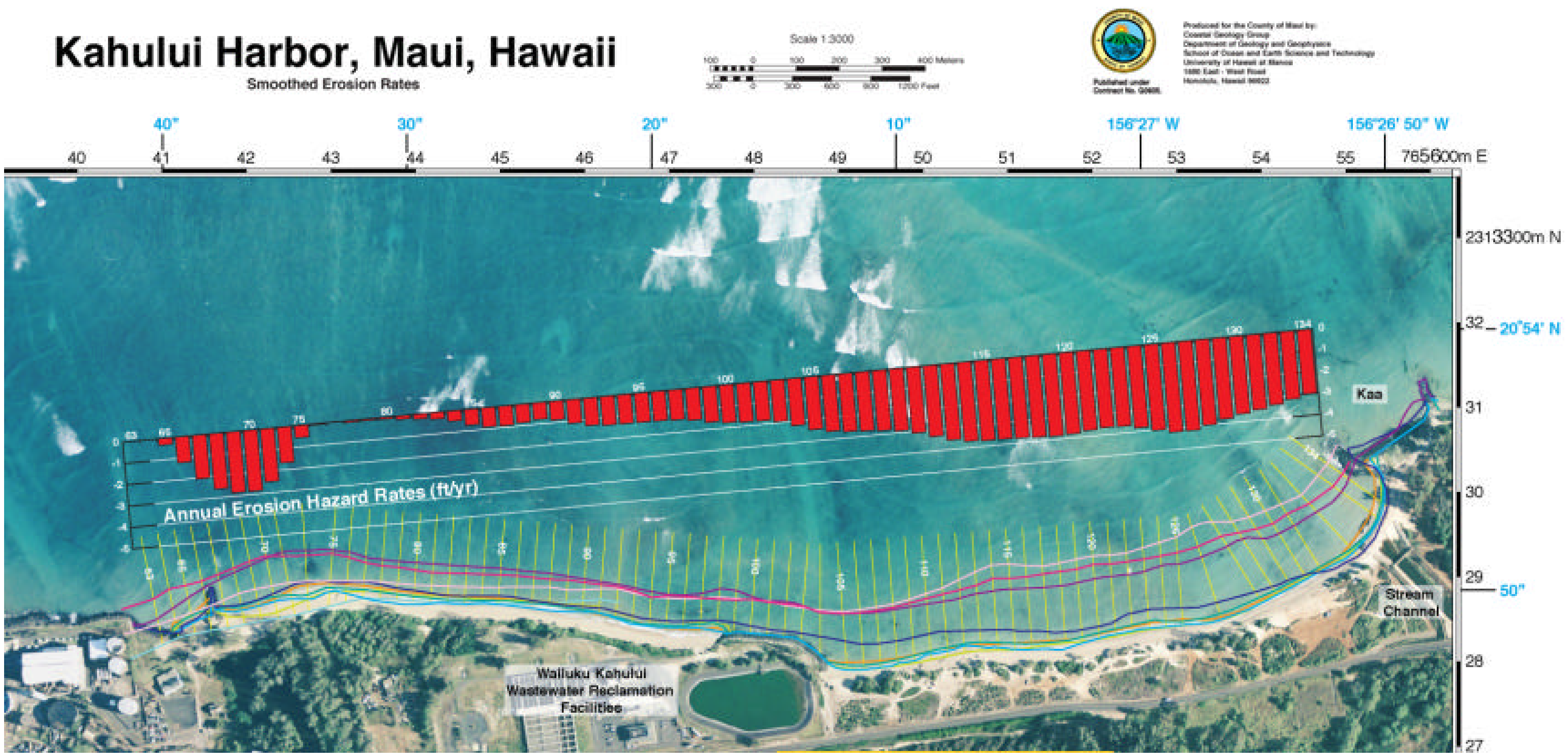


Figure 8. County of Maui Shoreline Erosion Map at the Wailuku-Kahului Wastewater Reclamation Facility.

B. Shorter-Term and Current Shoreline Changes

This section includes analysis of the historic data and summarizes the changes in shorter (decadal) intervals. This will provide a better understanding of how the shoreline erosion has changed over time. The data used in the County of Maui Shoreline Erosion Maps was obtained to determine short-term erosion rates. Shorter-term erosion rates will provide information as to whether the erosion is increasing, decreasing, or constant through time and may aide in assessing potential causes for erosion based on historical events. Also, the data presented in Sea Engineering (1991) report will be compared to the County of Maui shoreline data.

Figure 9 through Figure 11 illustrate shorter-term erosion trends between the various surveys available for this coast. The shoreline position at each transect was subtracted from the previous shoreline position and then divided by the number of years between shoreline surveys. This produces a shoreline change rate in feet per year (ft/yr). Each Figure shows the shoreline change rate along each of the transects indicated on the County Shoreline Erosion Maps. For reference, station 70 of the County Shoreline Erosion Map is located west of the WWRF property, and Station 134 is located at Kaa, east of the Stream Channel.

1. 1912-1929 and 1929-1960

Figure 9 shows that from 1912 to 1929 (dashed red line), there is a trend of shoreline advance west of the WWRF and slight erosion occurring east of the facility. The accretion west of the site is typical for a westward longshore transport where the littoral sediments move from the east to the west and are trapped at the East Jetty at Kahului Harbor (East Jetty construction began in 1906). The rate of accretion decreases to approximately 0.0 ft/yr along the shoreline just fronting where the revetment and retention pond is now located. From the location of the revetment to approximately 400 feet east, the shoreline has a slight erosional trend on the order of -0.5 ft/yr. From approximately 400 feet east of the pond and revetment to the end of the reach, this rate of shoreline change increases to approximately –4.0 ft/yr.

The next time step shown in Figure 9 represents the shoreline change rate from 1929 to 1960 (blue solid line). This graph shows the beach west of the WWRF is advancing at a much lower rate than the previous time interval (approximately 1.0 ft/yr). East of the facility, the rate of shoreline recession is slightly less than the 1912-1929 time interval (approximately 1.0 to 2.0 ft/yr). The shoreline immediately fronting the location of the WWRF revetment is similar between the two time intervals (e.g., 0.0 ft/yr).

The reason for change in the rate of shoreline advance is not known, but it could be speculated that the impoundment area could have reached its maximum capacity, and thus no further shoreline advance would occur. Another possible scenario is that the sand mining operations were started in the early part of the century (Guild 1999), which may have contributed to the erosional trend to the east. In fact, Moberly (1964) states sand mining was being conducted along the eastern end of reach. This would cause less sediment available to the longshore transport, and may contribute to the lower shoreline advance rate west of the WWRF.

Makai Ocean Engineering and Sea Engineering (1991) analyzed shoreline positions from 1950 and 1964 and determined that the shoreline change rate ranged from -2.9 ft/yr west of the WWRF, to almost -5 ft/yr near Kaa. These data are also shown on the Figure (blue triangles). These erosion rates are slightly higher than the 1929-1960 data. This increase in erosion may be because of the increased rate of sand mining during the latter part of this time interval.

2. 1960-1975 and 1975-1987

Figure 10 shows the shoreline change rate trends from 1960 to 1975 (red dashed line) and from 1975 to 1987 (solid blue line) from the County of Maui Shoreline Erosion Map data. Over the entire reach, the rate of shoreline erosion from 1960 to 1975 increased substantially, from about -8.0 ft/yr to the west of the WWRF, to over -16.0 ft/yr at the eastern bounds of the reach. This correlates to a 120-foot shoreline recession west of the WWRF to over 240 feet of recession adjacent to Kaa over the 15-year time interval. Data from Makai Ocean Engineering and Sea Engineering comparing 1964 and 1975 shoreline data are also plotted on the Figure (red diamonds). These data show close correlation between the time series with the County's data.

This dramatic increase in the erosion rate over these 15 years is most probably due to the sand mining efforts conducted during this time. Potential causes for shoreline erosion are presented in Section VI of this report.

The period from 1975 to 1987 (blue solid line) shows the rate of shoreline erosion is lessening over this time, but it is still significant. For this 12-year interval, the shoreline west of the WWRF has a change rate of approximately -2.0 to -4.0 ft/yr (25 to 50 feet of shoreline retreat). Immediately east of the WWRF revetment, the shoreline change dips to approximately -9.0 ft/yr (approximately 100 feet of shoreline retreat over 12 years). Along the remainder of the east reach, the shoreline change rate decreases from this -9.0 ft/yr to a slightly advancing beach (+2.0 ft/yr) at Kaa. The Makai Ocean Engineering and Sea Engineering data comparing the 1975 and 1988 shorelines are also plotted below (blue triangles). These data are very consistent with the County's data and show the same trends.

The decrease in the rate of shoreline recession could largely be due to the cessation of the sand mining efforts along this coast in the 1970s. Large-scale sand mining was prohibited in 1986 (University of Hawaii Sea Grant Extension Service and County of Maui Planning Department 1997).

3. 1987-1997 and 1997-2002

Figure 11 shows the shoreline change rate trends from 1987 to 1997 (red dashed line) and from 1997 to 2002 (solid blue line) from the County of Maui Shoreline Erosion Map data. For both data sets, the rate of shoreline erosion is substantially less than the previous time series, and in some locations the shoreline is accreting.

From 1987 to 1997, the shoreline west of the WWRF revetment has a change rate of approximately +2.0 ft/yr. This equates to a shoreline advance of approximately 20 feet. At the revetment, the shoreline change rate is 0.0 ft/yr. This is because the revetment is a fixed structure and does not change in time. East of the revetment, the shoreline shows a slightly erosional trend, on the order of 0.0 to -2.0 ft/yr.

The next time series compares the 1997 shoreline to the 2002 shoreline. This is shown on the Figure (blue solid line) and appears to have an opposite trend as the earlier time series. From 1997 to 2002, the shoreline west of the revetment has been eroding at a rate of -4.0 to -6.0 ft/yr (approximately 30 feet of recession). East of the revetment, the shoreline change rate is approximately +6.0 ft/yr and decreases to 0.0 ft/yr towards the eastern end of the reach. This change in trends from 1987-1997 to 1997-2002 suggests that the revetment at the WWRF is acting like a groin and causing accretion on the updrift side (east) and erosion on the downdrift side (west).

Both of these data sets represent more current trends in the shoreline. It appears that the beach is more stable now than it was in the 1960 to 1987 time intervals in that the rate of erosion is much less (maximum of -6 ft/yr compared to over -14 ft/yr) and is showing signs of accretion along some sections that has not been noted in the previous time intervals.

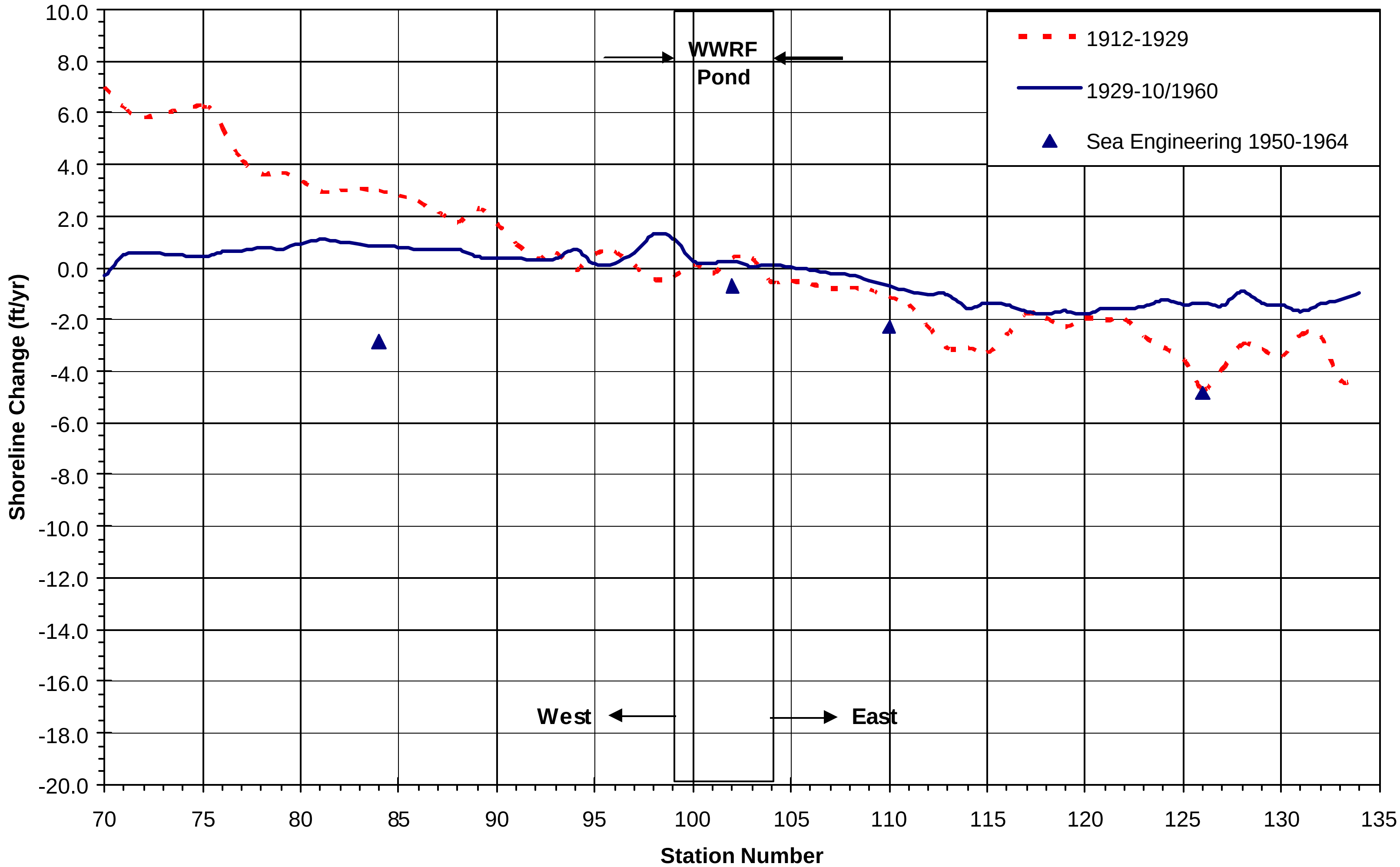


Figure 9. Shoreline Change Rate from 1912-1929 and 1929-1960 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data and Makai Ocean Engineering & Sea Engineering (1991)]

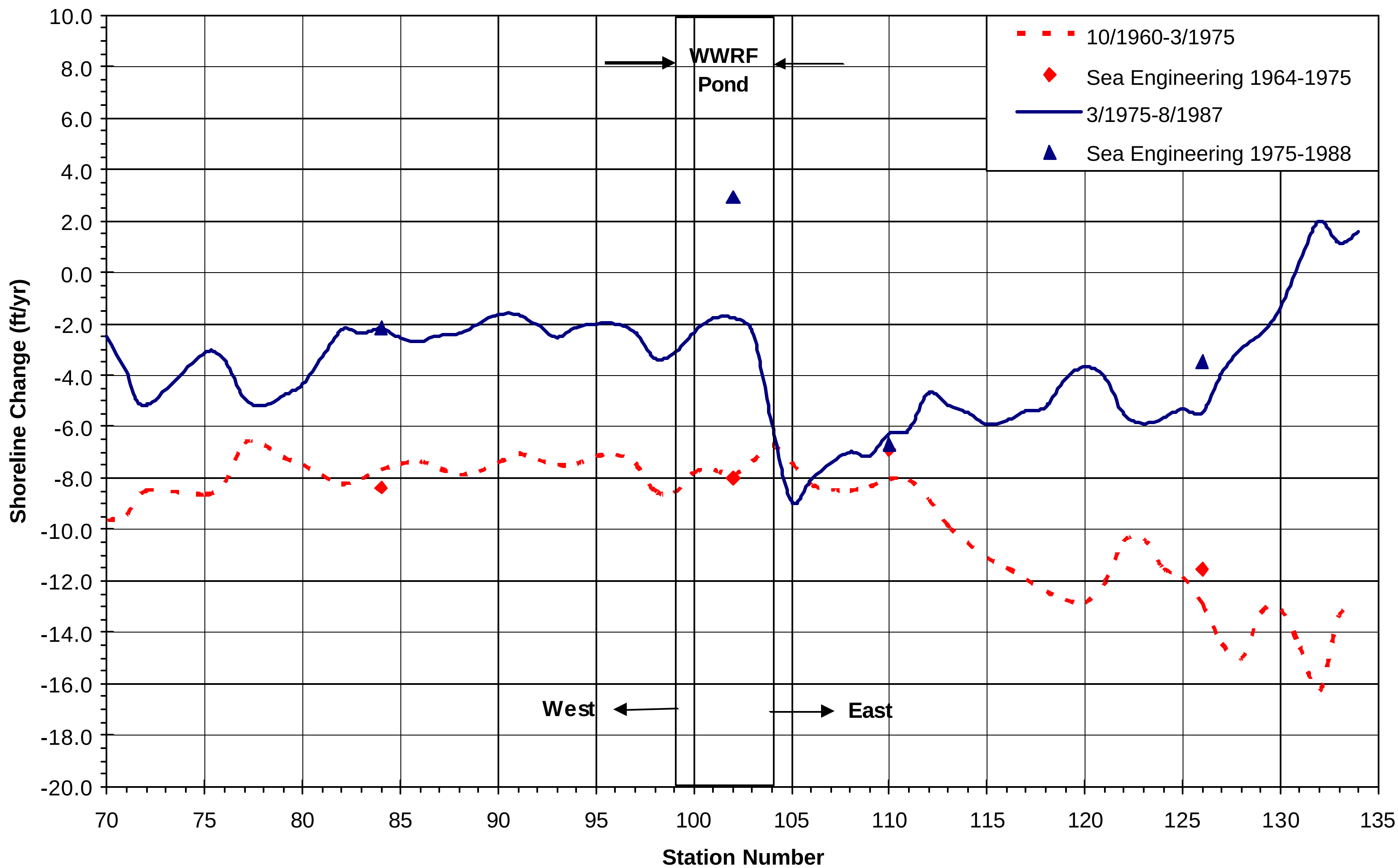


Figure 10. Shoreline Change Rate from 1960-1975 and 1975-1987 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data and Makai Ocean Engineering & Sea Engineering (1991)]

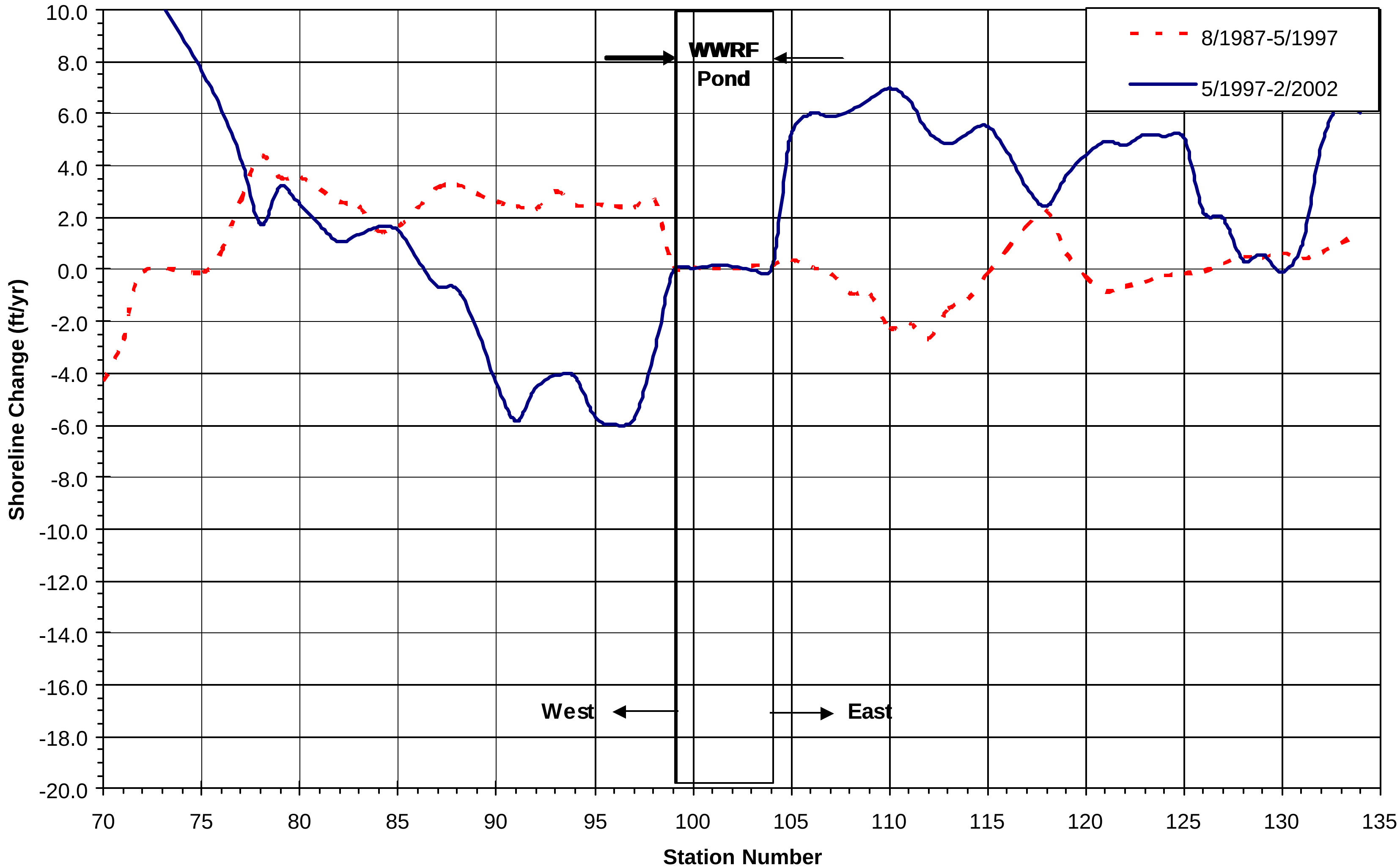


Figure 11. Shoreline Change Rate from 1987-1997 and 1997-2002 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data]

4. Recent Profile and Shoreline Survey Data

USGS profile data: Profile data from 1995 to 1999 were obtained from the USGS website (<<http://geopubs. wr.usgs.gov/open-file/of01-308/HTML1/Mnorth.html>>). A copy of the map indicating the locations of the profile stations is shown in Figure 12. For this study, the profile data at VKHL were reviewed to determine any current short-term trends in shoreline position near the WWRF. It is important to compare data from the same seasons (winter to winter) to obtain an accurate picture of the shoreline trends without the seasonal fluctuations.

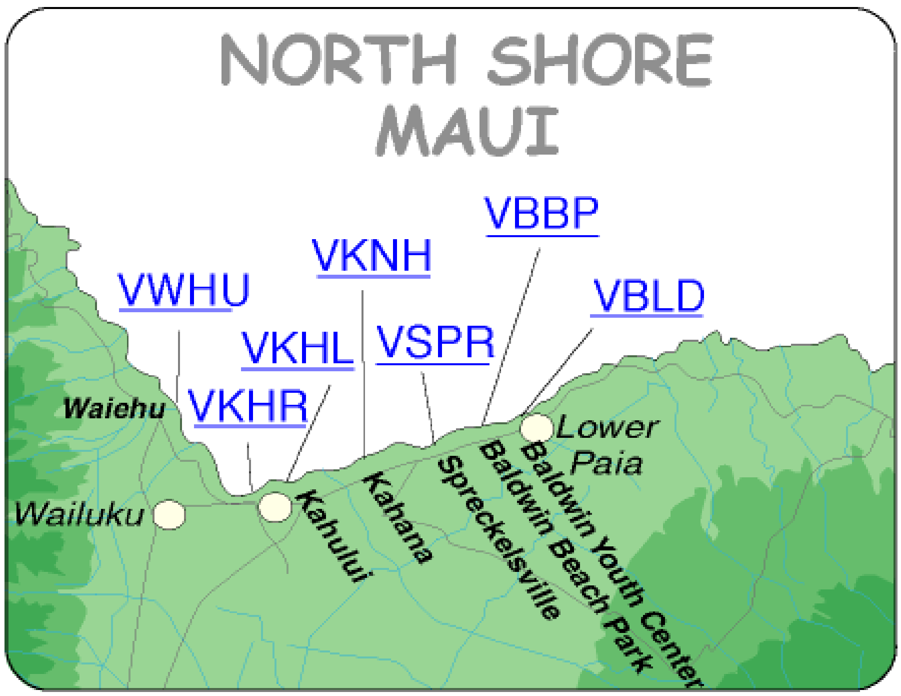


Figure 12. Location of the USGS profile transects on Maui's North Shore.

At VKHL, the winter profile data (Figure 13) show that from January 1995 (purple) to February 1996 (blue), the 0-meter depth contour receded approximately 12 meters. The shoreline position remained constant at this position through January 1998 (yellow). The January 1999 (black) data indicate that the shoreline had recovered (advanced) approximately 10 feet.

The summer profiles show a similar trend (Figure 14). The shoreline recedes approximately 10 feet between September 1995 (yellow) and August 1996 (red). By June 1997 (blue), the shoreline receded an additional 7 to 8 feet. The following two years, the shoreline advances, such that by July 1999 (black) the shoreline position is almost at the same position as the 1995 shoreline. These data indicate that the shoreline erosion trends along this reach are similar to those discussed in the previous section; the shoreline is fairly stable with trends of recession and accretion. Just comparing the 1995 and 1999 profile data at this location, it is seen there is a slight erosional trend, at least for this short time interval.

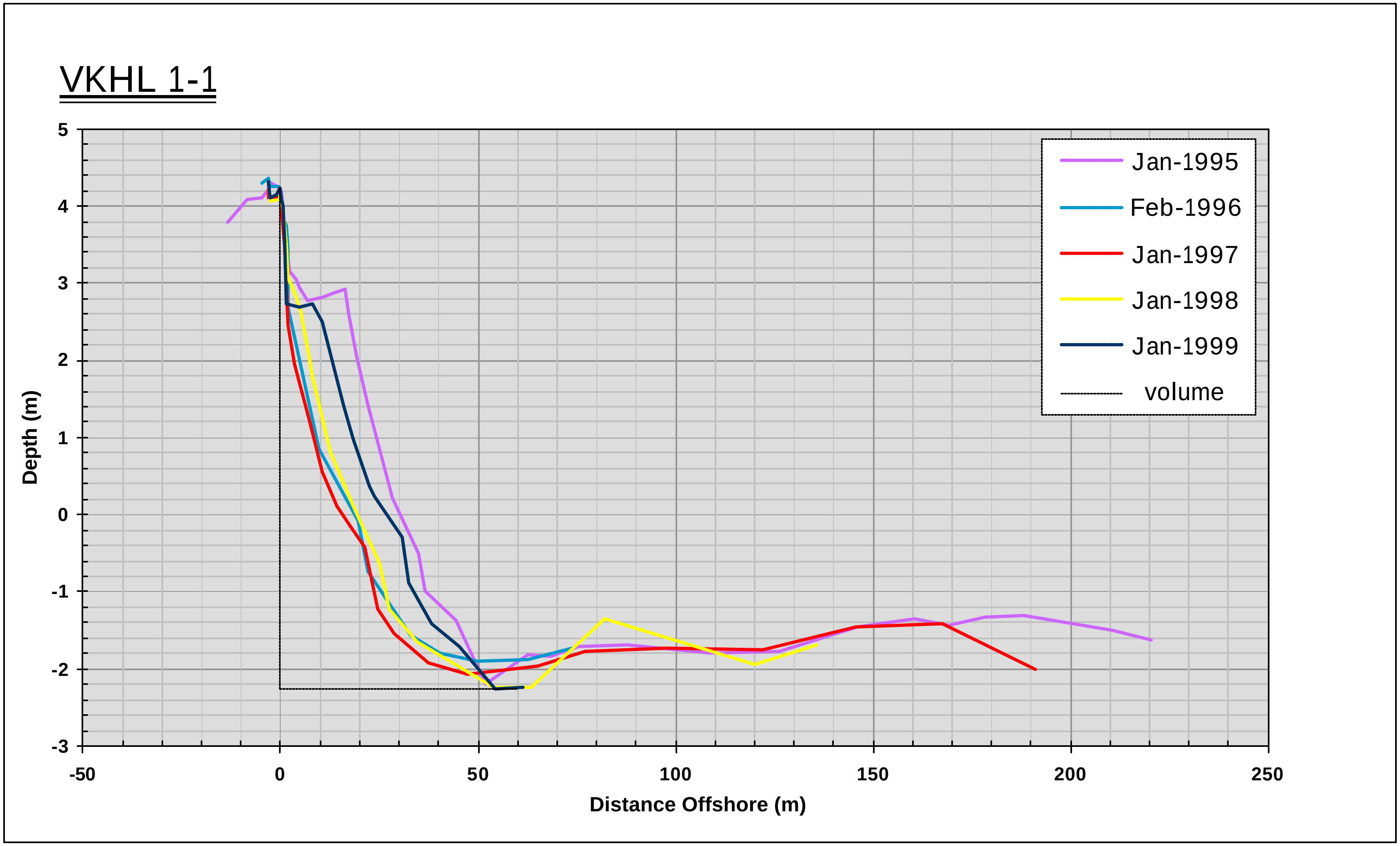


Figure 13. Winter profile data at VKHL from 1995 to 1999.

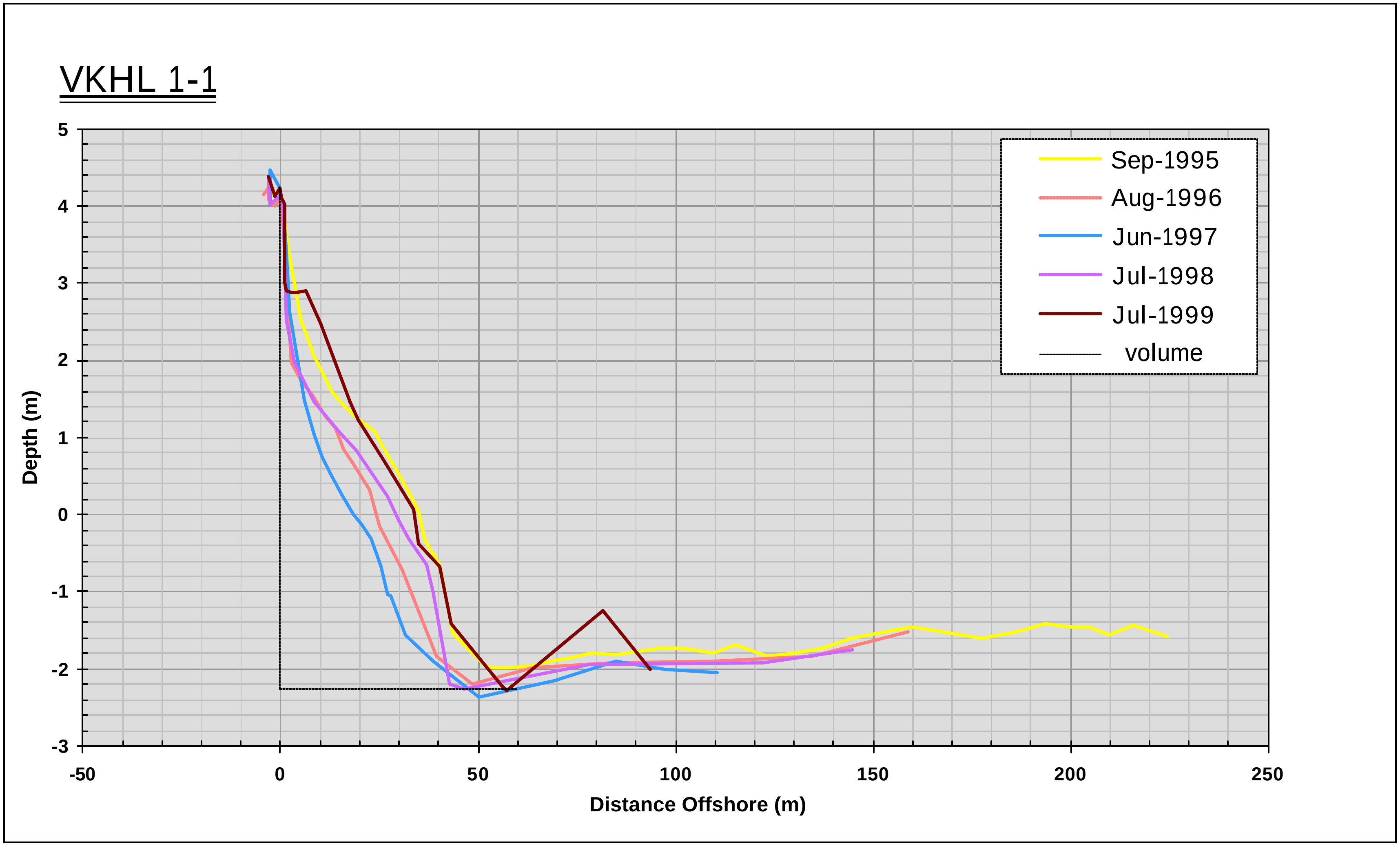


Figure 14. Summer profile data at VKHL from 1995 to 1999.

V. WAILUKU WWPS SHORELINE CHANGES

A. Long-Term Changes

This section discusses long-term shoreline changes over the last 50 to 100 years at the WWPS. The section of coast from one-half mile northwest of Waihee, south to Kahului Harbor is generally characterized as a depositional coast (Moberly 1963) due to the Waihee Reef and Iao Stream. The delta of the Iao Stream is located at Nehe Point, about one-half mile north of the WWPS. The Waihee Reef extends along the coast, with its width narrowing towards the Kahului Harbor. The south section of this reach, including the location of the WWPS, is characterized as a "low, eroding sandy coast" (Moberly 1963).

The County of Maui Shoreline Erosion Maps were obtained for the Waiehu reach, which includes the location of the WWPS (see Figure 15). The earliest shoreline position on the County Maps is the 1899 shoreline, followed by 1912, 1929, 1960, 1975, 1987, 1988, 1997, and 2002. The long-term shoreline erosion rate for the section of coast from Nehe Point to the Kahului Harbor west jetty is indicated on the below figure. The red bars indicate the Annual Erosion Hazard Rate (AEHR) in feet per year (ft/yr). Along the entire reach, the AEHR ranges from 0.0 ft/yr to -1.0 ft/yr. Directly fronting the WWPS, the historic long-term AEHR is approximately -0.3 ft/yr.

B. Historic and Current Decadal Shoreline Changes

Similarly to Section IV.B, this section will look at the historic data and summarize the changes in shorter (decadal) intervals. This will provide a better understanding of how the shoreline erosion has changed over time. The data used in the County of Maui Shoreline Erosion Maps was obtained to determine short-term erosion rates. Shorter-term erosion rates will provide information as to whether the erosion is increasing, decreasing, or constant through time and may aide in assessing potential causes for erosion based on historical events.

Figure 16 through Figure 18 illustrate shorter-term erosion trends between the various surveys available for this coast. The shoreline position at each transect was subtracted from the previous shoreline position and then divided by the number of years between shoreline surveys. This produces a shoreline change rate in feet per year (ft/yr). Each Figure shows the shoreline change rate along each of transect indicated on the County Shoreline Erosion Maps. For reference, station 135 of the County Shoreline Erosion Map is located south of Nehe Point and Station 197 is located adjacent to the west jetty at Kahului Harbor.

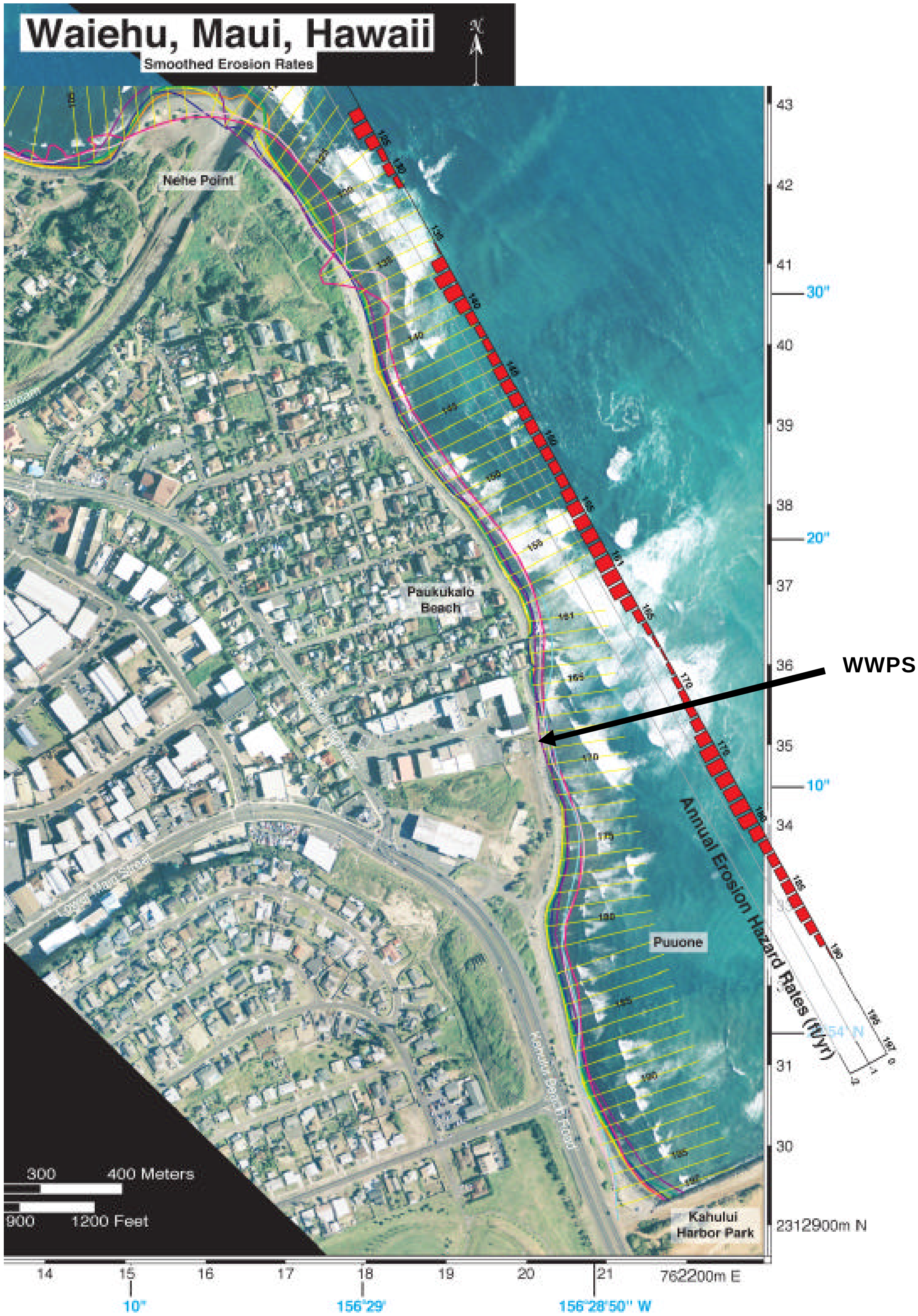


Figure 15. County of Maui Shoreline Erosion Map at the Wailuku Wastewater Pump Station.

1. 1912-1929 and 1929-1960

Figure 16 shows that from 1912 to 1929 (dashed red line), there is a trend of shoreline advance along most of the shoreline reach. The rate of change varies from 0.0 ft/yr to +2.0 ft/yr. Directly fronting the WWPS, the rate of change is approximately +1.0 ft/yr.

The next time step shown on Figure 16 represents the shoreline change rate from 1929 to 1960 (blue solid line). During this time interval, the shoreline trend reverses to slightly erosional over the entire reach. The Figure indicates that there is a -1.0 to -2.0 ft/yr erosion rate.

2. 1960-1975 and 1975-1988

Figure 17 illustrates the data from 1960 to 1975 and from 1975 to 1988. From 1960 to 1975, the shoreline along this reach remained slightly erosional, with trends ranging from 0.0 ft/yr to -2.0 ft/yr. Directly fronting the WWPS, the shoreline exhibits a positive shoreline change of over +2.0 ft/yr.

The following time interval from 1975 to 1988, the shoreline exhibits a slightly more erosional trend, ranging from 0.0 ft/yr to -2.0 ft/yr. The shoreline fronting the WWPS has a slight erosion rate of -1.0 ft/yr over these 12 years.

3. 1988-1997 and 1997-2002

Figure 18 presents the shoreline change rates between 1988 and 1997 and between 1997 and 2002. From 1988 to 1997, there was a slight erosional trend along most of the reach on the order of 0.0 ft/yr up to -2.0 ft/yr. Immediately fronting the WWPS, the shoreline was stable, with slight accretion (0.0 to +1.0 ft/yr).

From 1997 to 2002, the shoreline had a reversed to a slight accretional trend along the reach. Along most of the reach, the shoreline changed from 0.0 ft/yr to +2.0 ft/yr. At the WWPS, the shoreline appears to have an erosion-accretion wave with change rates from -2.0 ft/yr to +2.0 ft/yr. South of the site, towards the harbor, the shoreline position advanced from +2.0 to +4.0 ft/yr, which equates to a shoreline advance of 10 to 20 feet.

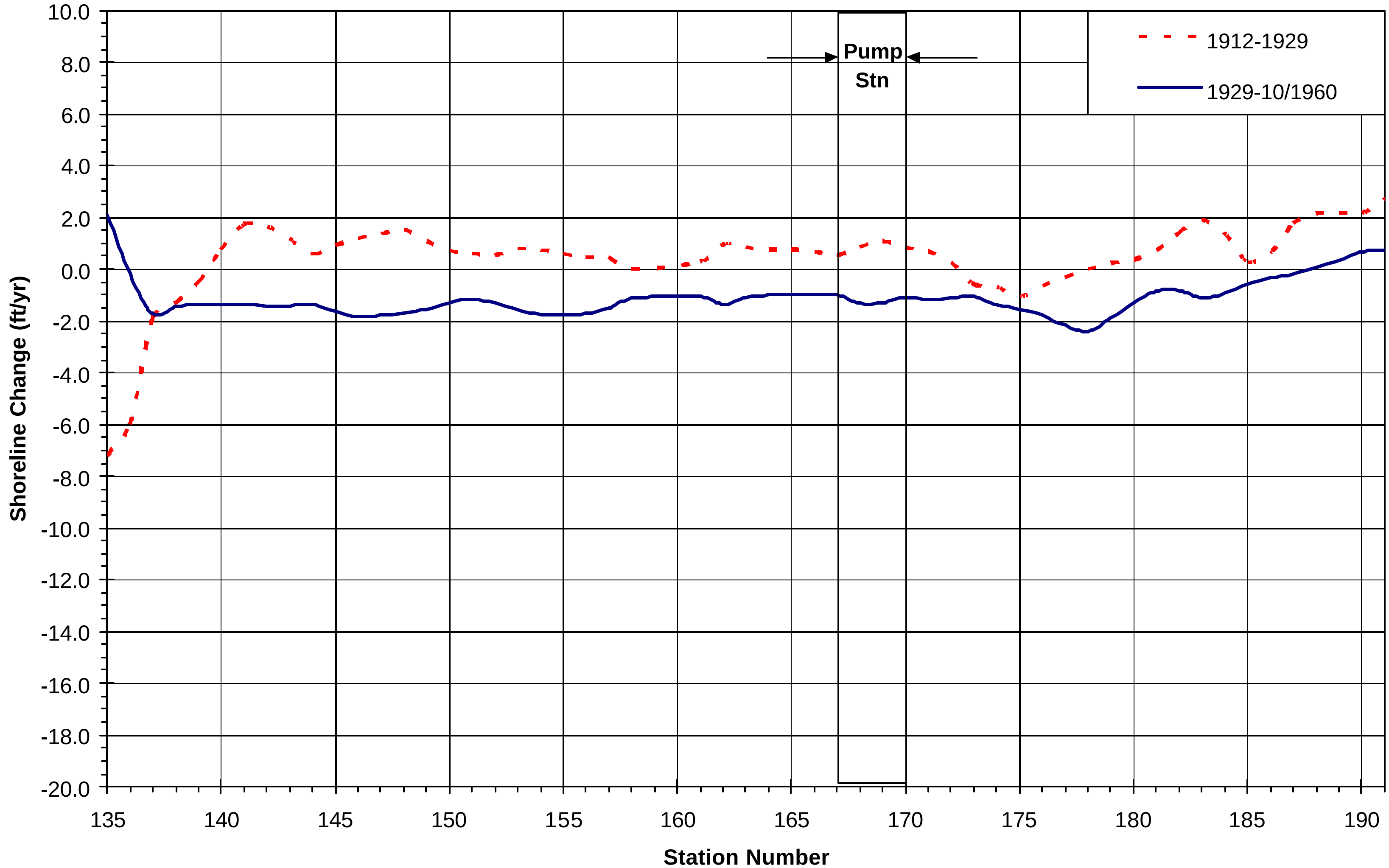


Figure 16. Shoreline Change Rate from 1912-1929 and 1929-1960 at the WWPS.

[from UH and County of Maui Shoreline Erosion Map data]

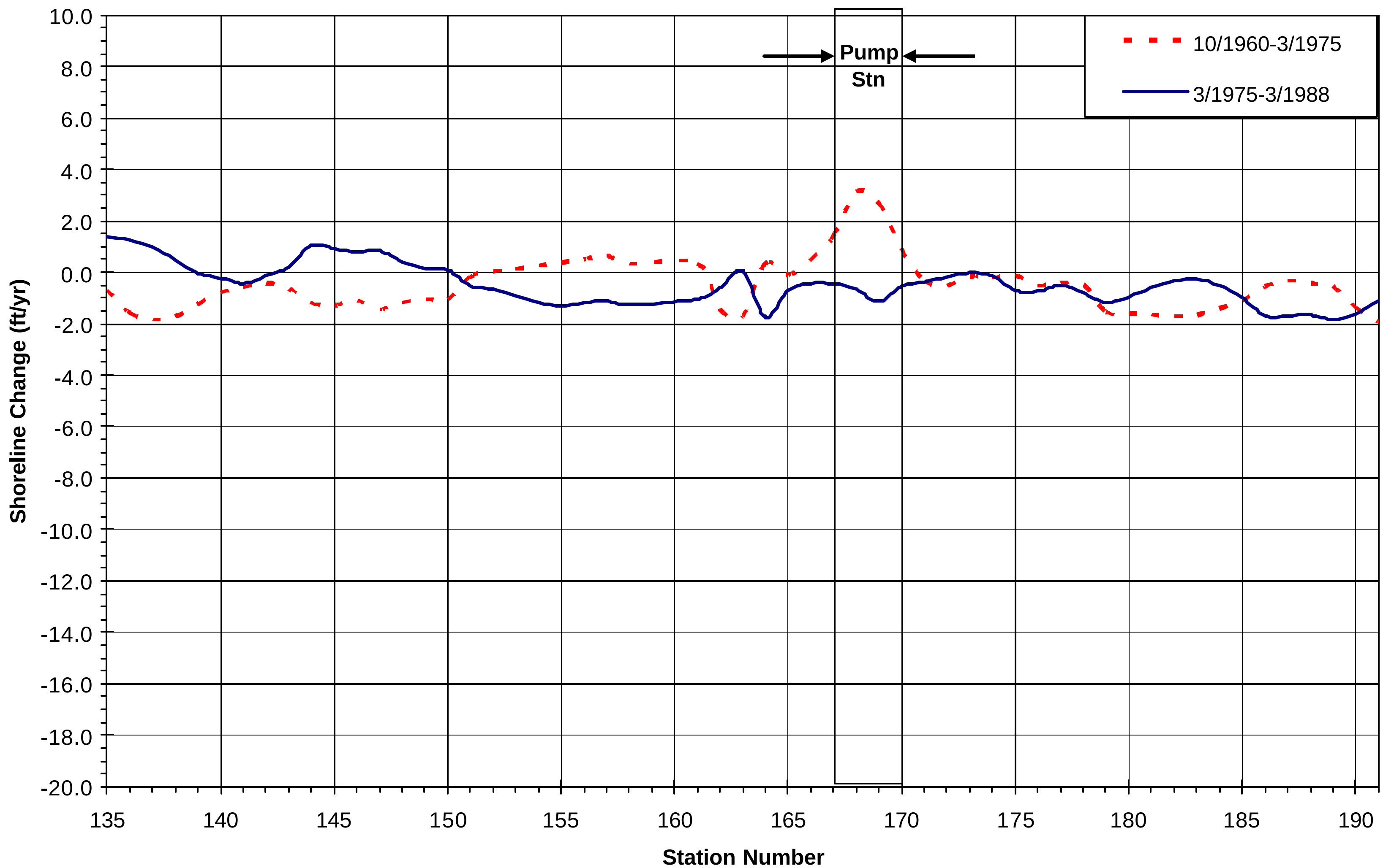


Figure 17. Shoreline Change Rate from 1960-1975 and 1975-1988 at the WWPS.

[from UH and County of Maui Shoreline Erosion Map data]

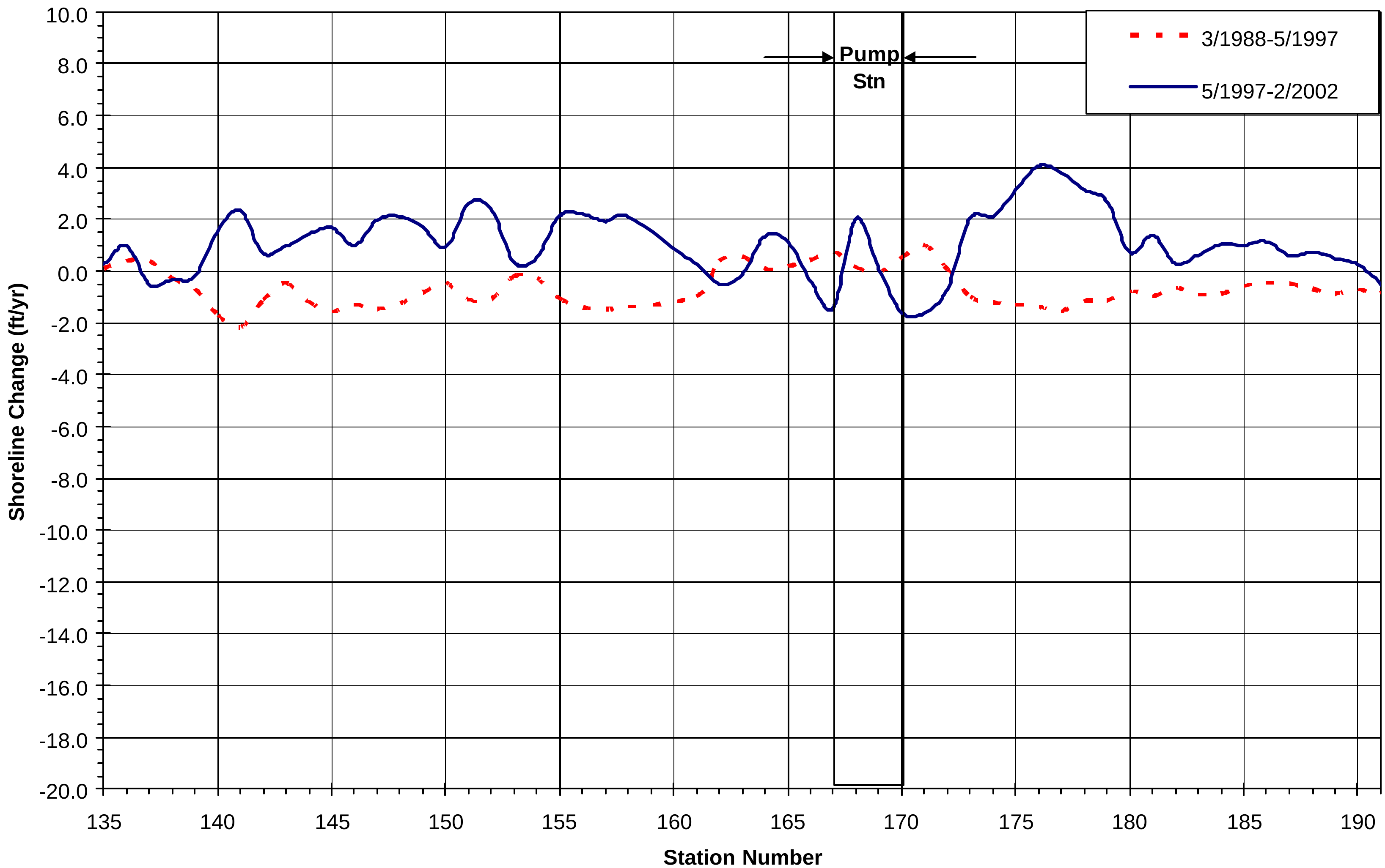


Figure 18. Shoreline Change Rate from 1988-1997 and 1997-2002 at the WWPS.

[from UH and County of Maui Shoreline Erosion Map data]

VI. POTENTIAL CAUSES OF EROSION

There are both natural and man-made influences that can contribute to shoreline erosion. The naturally occurring influences may include sea level rise, storm impacts, tsunamis, and reef changes. Man-made influences include, but may not be limited to harbor construction, shore protection structures, sand mining, damage to dune system, and reef destruction. This section presents some of the potential causes for erosion at the project area.

A. Natural Influences

1. Sea Level Rise

Relative sea level changes on the Hawaiian Islands are caused by rising sea levels, caused by global warming, and land subduction, caused by the plate movements of the islands. Globally, the mean sea level has risen by 10 to 30 cm (4 to 12 inches) over the last century. Sea level is projected to rise twice this amount (2 feet) over the 21st Century (Fletcher, et al. 2002).

In the Hawaiian Islands, the long-term trend of sea level rise caused by land subduction decreases from the island of Hawaii to the northwest (D. Jeon 1995). Therefore, the island of Maui subsides faster than Oahu and Kauai, since it is located closer to Hawaii. Tide gauge data from Kahului, Maui shows a relative sea level rise of 2.46±0.23 cm per decade (0.97±0.09 inches per decade). Approximately 1.3 cm per decade of this amount is caused by global sea level change.

Several studies indicate that future sea level rise may increase considerably (Fletcher 1992 and Fletcher *et al.* 2002). The median sea level increase on Maui is predicted to be 9.1 inches over the next 50 years and over 19 inches over the next century. With the average slopes in Hawaii varying from 1:15 to 1:6, this equates to a shoreline recession of 6 to 15 inches for every inch of sea level rise (Oceanit Laboratories, Inc. 1997).

At the Kahului Beach area, the USGS profile data indicate the shoreline slope is approximately 10 feet horizontal to one foot vertical (Brown & Caldwell 2002). With this slope a one-inch change in sea level relates to a 9.7-inch change in the relative shoreline position per decade (approximately 0.081 feet per year, or 0.97 inches per year). Overtime, the erosive effects of storms could be enhanced because of the rising sea levels.

2. Storms (Wave-induced flooding)

Elevated water levels (storm surge and wave setup) during storm events provide an elevated platform for the large storm waves to react with the shoreline. The waves can then reach higher on the beach profile and cause upper beach and dune erosion. This is evident at the WWPS site, where storm waves were elevated and reached the upper reaches of the back beach, causing sever erosion and escarpments.

3. Reefs

It has been speculated (Sea Engineering 1991 and Guild 1999) that the reefs located offshore of the Sprecklesville Beach area may not be as productive as they have been in the past. If the reef is less productive, then there would be a decrease in the coralline sand washed onshore from the reef system. The most important function of the reefs is the protection they offer against erosion (Levin 1970).

Stream flooding can cause significant flows from Maui's rivers. The discharge can cause high levels of turbidity in coastal waters. The increased turbidity, if prolonged, may have an adverse impact on the local reefs.

B. Man-Induced Influences

1. Kahului Harbor

Limited study has apparently been done assessing the effects of Kahului Harbor and its jetties on the adjacent shoreline. The long-term effects of the structures and dredging practices are not known at this time.

2. Sand Mining

In 1954, it was estimated (Cox) that approximately 12,000 cy/yr of sand had been mined from the beach area to the east of the WWRF. The sand mining continued into 1970s. The effects of this practice is evidenced in Figure 10, which shows the rate of shoreline erosion was -8 to over -16 ft/yr along the beach reach fronting the WWRF.

Also, Levin (1970) states the dredging during the sand mining efforts change the bathymetry of the nearshore area, creating "new deep water areas" and may also cause turbidity which can affect the adjacent reef systems. As stated in the previous section, reefs are needed to provide protection against erosion. Since the cessation of the sand mining, the erosion rate in this area has substantially lessened. Current shoreline change rates are around -6.0 to +6.0 ft/yr.

3. WWII Training Exercises

WWII training exercises destroyed portions of Maui's reefs during the early to mid-1940s. This is evidenced on South Maui, at south Kalama Park in 1943-1945. The Navy underwater demolition team blew up reef as practice for beach landings for the war in the Pacific. Also, there is evidence that other reefs in south Maui were destroyed by the Navy in

1945 at the request of the County of Maui in an attempt to improve the quality of the swimming beach (Halama Beach Homeowners Association 1999).

Evidence supporting these types of activities on Maui's north shore have not been found, but it has been speculated that some of the WWII training exercises did take place along Sprecklesville Beach area.

4. Dune Destruction

Dunes are important components to the coastal processes. Dunes serve to trap wind-blown sand, store excess beach sand, and serve as natural erosion protection. Increased public access over the natural dune system can destroy the natural stabilizing dune vegetation. Also, flood control channels that cross the natural dune system can contribute to the dune destruction. Both of these cases cause direct sand loss, as well as allowing wind-blown sand to migrate inland of the shoreline and out of the littoral system. A region-wide dune restoration project could have a significant impact on reduction of shoreline erosion. This type of program is recommended by the Beach Management Plan for Maui (1997).

VII. NO-PROJECT ALTERNATIVE

A. WWRF

The most recent shoreline surveys indicate the shoreline west of the WWRF revetment is eroding at a rate of up to six feet per year. The average shoreline change rate along the WWRF property is approximately -2.4 feet per year. The County of Maui shoreline Erosion maps indicate the long-term Annual Erosion Hazard Rate (AEHR) is -2.2 feet per year along the coast from Hobron Point to Kaa.

For the no-project alternative, it is assumed that current shoreline change trends will continue in the future and no further shoreline protection will be constructed at the site. A 2001 shoreline survey and site map of the WWRF (Brown and Caldwell 2002) were analyzed to determine when the first structures at the WWRF site could be threatened. This site map is illustrated in Figure 19. The equation below was developed to calculate the years until a structure is threatened.

$$Y = \frac{D - W}{SL + LTE}$$

Where D is the distance between the structure and the back of the beach (approximately the +10-ft contour), W is the winter recession, SL is the shoreline recession due to sea level rise, and LTE is the current longer term erosion rate.

Maximum and Average values were used for the winter recession and the current erosion rate to calculate a range of years until the structures are threatened.

For this analysis, it is assumed the revetment will remain and be maintained in place and will provide protection to the holding pond and other upland structures behind the revetment. It is assumed the revetment has ceased further erosion to the area immediately behind it.

Table 3 below outline the approximate number of years until WWRF structures could be threatened using both, the maximum current erosion rate (-6.0 feet per year) and the average current erosion rate (-2.4 feet per year) (See Section IV for further details on these rates) . The seasonal recession was determined from analyzing the USGS profile data from 1995 to 1999. For this time period, the minimum recession is 0 ft (no change between summer and winter) and the maximum is 53.5 ft between summer and winter. It is noted that these data are very limited and no extreme storms or large hurricanes occurred during the 1995 to 1999 time period (Gibbs, Richmond, and Fletcher 2000). Section VI.A discusses the effects of sea level rise and states that a change of approximately 0.081 feet of horizontal recession occurs every year at the project area as a result of relative sea level rise.

Subtracting the winter recession (W) from the distance of the structure to the back of the beach (D), and then dividing by the combined erosion rate (SL + LTE), gives the time before the structure is considered threatened.

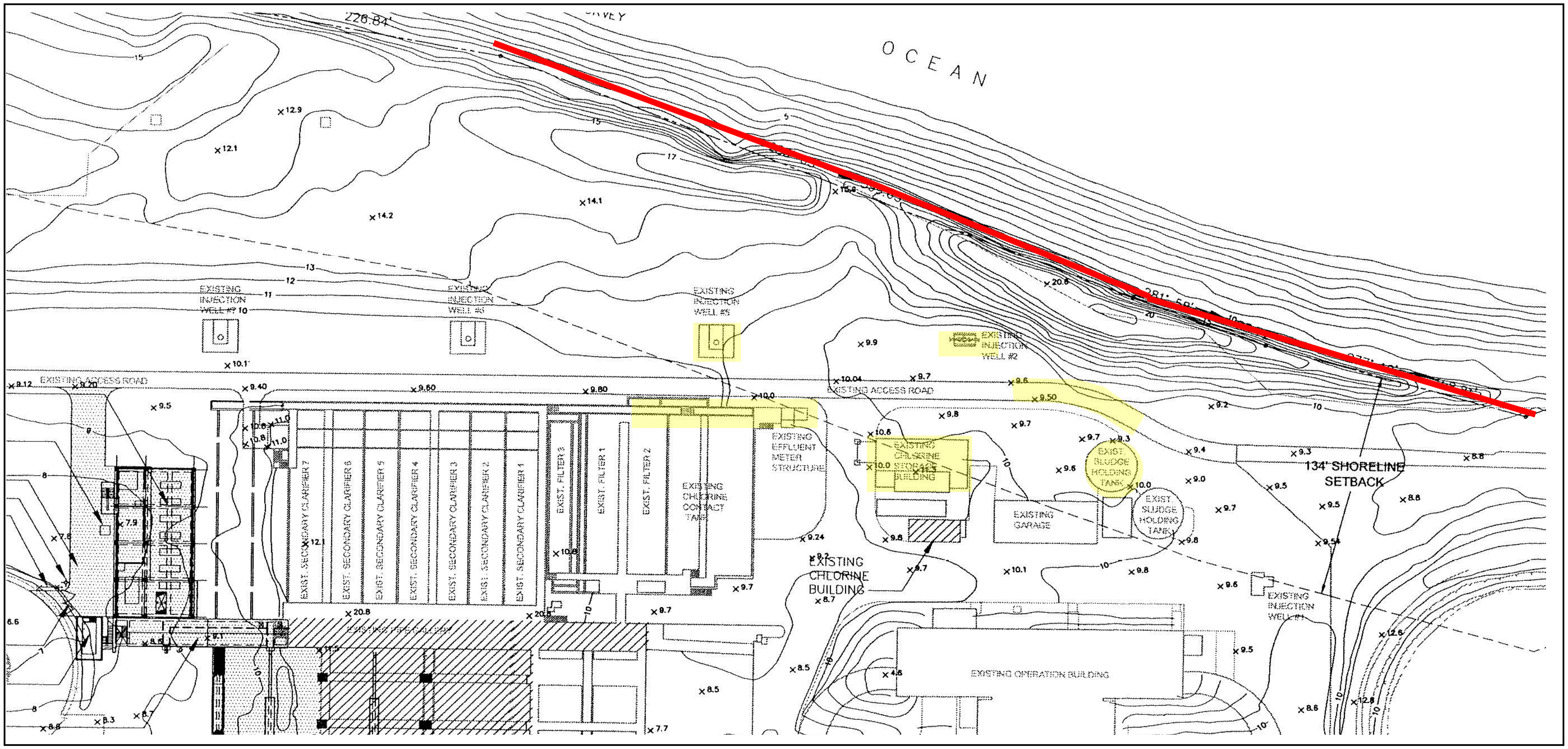


Figure 1. Wailuku-Kahului Wastewater Reclamation Facility
[from Brown and Caldwell 2002]

Table 3. Calculation of Years until WWRF Structures are Threatened.

		MINIMUM/AVERAGE CONDITIONS				MAXIMUM CONDITIONS			
Structure	**Distance between top of berm and structure (ft)**	**Minimum Winter Recession (ft)**	**Average Recent Erosion Rate (ft/yr)**	**Sea Level Rise Recession Rate (ft/yr)**	**Approx. Yrs until Threatened**	**Maximum Winter Recession (ft)**	**Maximum Recent Erosion Rate (ft/yr)**	**Sea Level Rise Recession Rate (ft/yr)**	**Approx. Yrs until Threatened**
Existing Access Road	65	0.0	2.4	0.0807	26	53.5	6.0	0.0807	2
Sludge Holding Tank	90				36				6
Chlorine Storage Bldg	120				48				11
Effluent Meter Structure	140				56				14
Existing Injection Well #2	72				29				3
Existing Injection Well #5	110				44				9

Table 3. Calculation of Years until WWRF Structures are Threatened. (Continued)

		MIN-MAX CONDITIONS				MAX-AVG CONDITIONS			
Structure	**Distance between top of berm and structure (ft)**	**Minimum Winter Recession (ft)**	**Maximum Recent Erosion Rate (ft/yr)**	**Sea Level Rise Recession Rate (ft/yr)**	**Approx. Yrs until Threatened**	**Maximum Winter Recession (ft)**	**Average Recent Erosion Rate (ft/yr)**	**Sea Level Rise Recession Rate (ft/yr)**	**Approx. Yrs until Threatened**
Existing Access Road	65	0.0	6.0	0.0807	11	53.5	2.4	0.0807	5
Sludge Holding Tank	90				15				15
Chlorine Storage Bldg	120				20				27
Effluent Meter Structure	140				23				35
Existing Injection Well #2	72				12				7
Existing Injection Well #5	110				18				23

The previous tables illustrate that in as few as 3 years, the existing injection well #2 could be threatened using the maximum current erosion rate and maximum winter recession rate that was observed from 1995 to 1999. The access road could be threatened in as few as 2 years and the existing sludge holding tanks in as few as 6 years. The chlorine storage building is located approximately 120 feet from the fence line, which relates to a minimum of 11 years before the structure is threatened using the maximum erosion rate and seasonal change. Table 4 below outlines the structures evaluated on the WWRF site and the minimum, maximum, and average time until each structure is considered threatened. These values are also supported by the recent exposure of an effluent line east of the revetment resulting from the erosional trends and winter storm response at the beach.

Table 4. Summary of WWRF Structures that may be Threatened.

Structure	Approx. Minimum Time (yrs)	Approx. Maximum Time (yrs)	Approx. Average Time (yrs)
Existing Access Road	2	26	11
Sludge Holding Tank	6	36	18
Chlorine Storage Bldg	11	48	26
Effluent Meter Structure	14	56	32
Existing Injection Well #2	3	29	13
Existing Injection Well #5	9	44	24

It is possible that most of these structures identified above could be relocated elsewhere on the WWRF property. However, the northeast corner of the Chlorine contact tank and effluent meter structure is located approximately 140 feet from the existing fence line. The size of this structure and its position in the wastewater treatment cycle would prohibit it from being relocated elsewhere on the property. With this distance, the chlorine contact tank and effluent meter could be threatened in as little as 14 years.

Also, observations during the site visit on July 16, 2004, indicated signs of flanking around the ends of the revetment. If this flanking continues, the revetment could become unstable and the shoreline in its immediate shadow may take on erosion hot-spots. It is imperative that the revetment be maintained for the life of the WWRF to provide protection to the upland structures.

B. WWPS

The shoreline at the WWPS is naturally protected by rubble beach from further short-term erosion. However, the upland property and structures are not protected from erosion caused by storms (elevated water levels and subsequent wave attack). Therefore, the upland property will continue to fail and erode during large storms unless protection is offered. Estimating the amount of time before structures at the WWPS are threatened is difficult to assess since the majority of erosion at this site is caused by large storms and waves, which occur at irregular intervals.

VIII. POTENTIAL PROJECT ALTERNATIVES AT THE WWRF

This section reviews potential alternatives for protection of the WWRF property. The alternatives that are presented include beach nourishment, groins with beach nourishment, revetment, revetment with beach nourishment, and coral rubble revetment.

A. Alternative 1 - Beach Nourishment

Beach nourishment is a proven method to stabilize a shoreline against erosion and protect threatened upland areas. However, there is very limited beach nourishment experience in Hawaii, especially using offshore sand sources. This limited experience makes it difficult to predict performance as well as assess construction and maintenance costs of a larger-scale beach nourishment project. Historically, most small-scale beach nourishment projects on Maui have used sand from inland sources. These inland sediments are typically finer grained than the natural beach sand, and may not be the most compatible sediments available for large-scale projects, such as the WWRF beach site.

Recent smaller-scale beach nourishment projects have occurred on Maui at Sugar Cove, located approximately 4 miles east of Kahului Harbor. These projects include trucking sand from the inland quarries and placing the material in a small (600-ft long) pocket beach. The initial nourishment costs were approximately $100,000 and approximately $20,000 per year for ongoing maintenance. From 1995 to 2000, Sugar Cove has placed approximately 18,000 cy of sand on their beach. The larger projects during this time included approximately 5,800 cy in 1996 and approximately 6,300 cy in 1998. Research indicates the Sugar Cove project has purchased and placed the sand for about $12/cubic yard from the local inland source. All of the project costs have been covered by the Sugar Cove residents and approvals for the projects have been readily obtained (<http://www.hawaii.gov/dbedt/czm/ce111997.htm>).

Another recent beach nourishment project is a pilot project at Waikiki, scheduled to begin in late February/early March 2005. This project is a small-scale pilot project that involves pumping 10,000 cy of sand from an offshore sand source to Kuhio Beach. Total project costs are approximately $450,000, which includes $320,000 for the direct cost of pumping the sand ($32 per cubic yard) (Eversole, e-mail communication, 2005).

The U.S. Army Corps of Engineers (USACE), Honolulu District, is conducting an erosion study in the Kihei area. The study will look at the restoration of approximately seven miles of shoreline. The study reach is on Maui's southeast coast and extends from Kihei park in the north to Keawekapu point in the south (USACE 2003). Potential sand sources should be identified in the study.

It is well established that beach nourishment projects constructed with larger volumes and coarser materials tend to remain on the upper portion of the beach for longer time periods. Smaller and finer-grained projects tend to disperse more rapidly and remain on the upper beach for a shorter time period. Therefore, it is important to use the best-suitable sand source for any beach nourishment project.

The two alternatives presented in this section propose to acquire sandy material from either upland and/or offshore sand sources and placed along the shore fronting the WWRF.

1. Alternative 1A – 4,000-ft Long Beach Nourishment

The project reach for this alternative extends from Kaa to the WWRF western property boundary; a distance of approximately 4,000 feet. The purpose of nourishing the entire reach is to allow for the upcoast (east) beach area to act as a feeder beach to the downcoast (west) beach area. Since the net sediment transport is from east to west, the material placed near Kaa would migrate west over time, offsetting some of the maintenance required for the downdrift area fronting the WWRF.

This alternative requires approximately 215,000 cy of initial fill placement to create an 80-foot wide berm to provide a sand buffer between the property and the ongoing erosion. The nourished beach would continue to erode as it would under natural conditions and periodic maintenance nourishments would be required for the life of the project. The USGS profile data indicate that the maximum seasonal variation along the shore at the WWRF is approximately 50 feet. Therefore, the project would require renourishment when the nourished beach width has receded approximately 30 feet, preserving the 50-foot seasonal change. It is estimated that approximately 85,000 cy would be required for this renourishment every 10 years to maintain the project design width. However, the frequency may be longer than this estimate if the updrift beach acts effectively as a feeder beach providing more material to the beach fronting the WWRF. Figure 20 provides a cross-section illustration of the beach fill at the site and Figure 21 provides a plan view of the project reach.

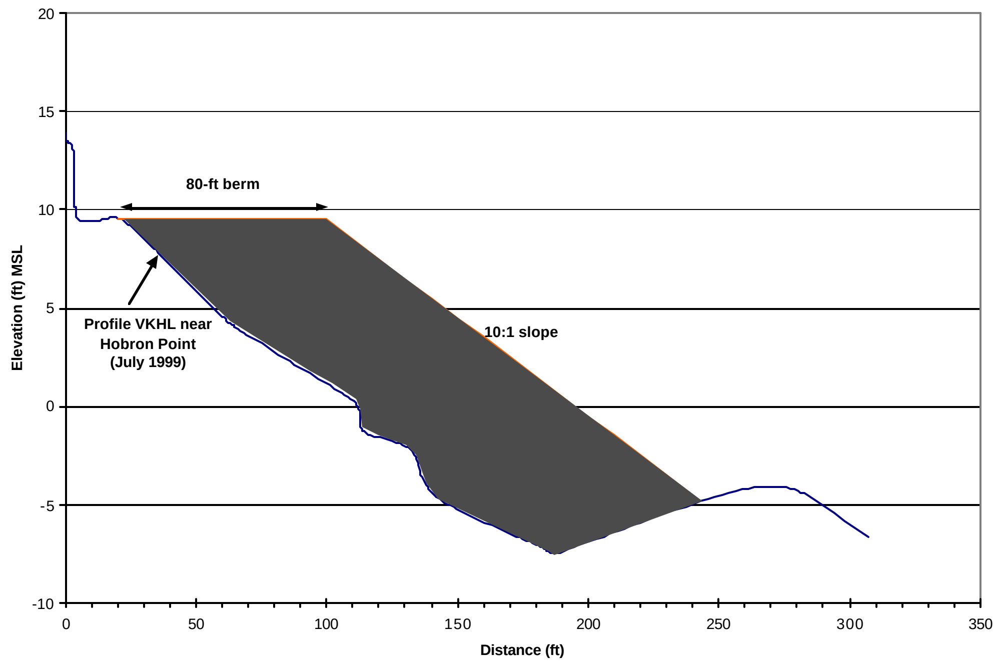


Figure 20. Alt. 1A and 1B - Cross-section of beach nourishment at the WWRF site.

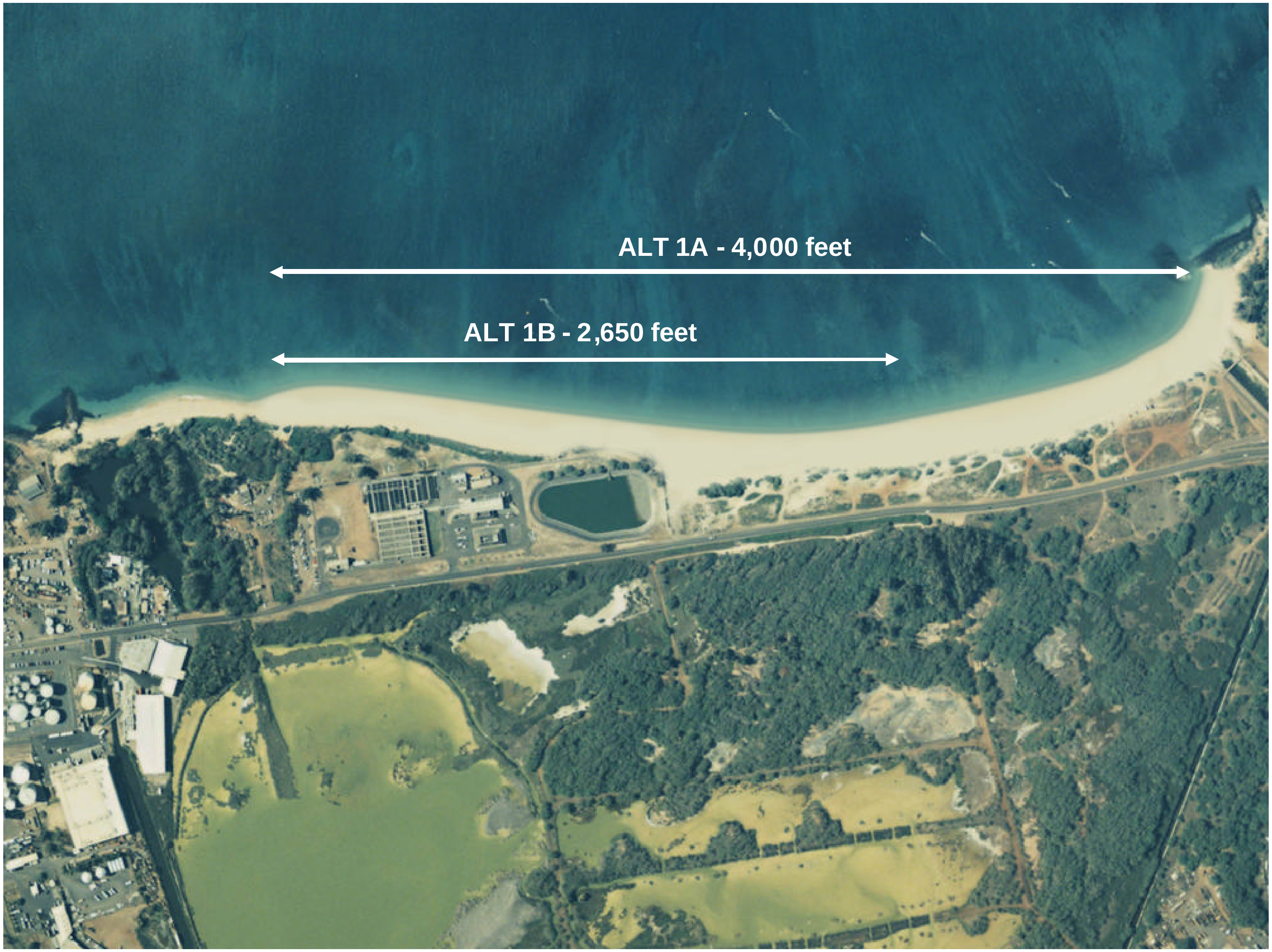


Figure 21. Plan view of the beach nourishment alternatives at the WWRF site.

2. Alternative 1B – 2,650-ft Long Beach Nourishment

This alternative is similar to Alternative 1A, above; however, the beach fill length is reduced to approximately 2,650 feet. The nourishment extends along the WWRF property to about 1,000 feet east of the existing revetment. Similar to above, the nourishment area would continue to erode as it would under natural conditions. However, smaller beach nourishment projects typically have less success with retaining beach area over the long term. Therefore, careful consideration should be exercised in analyzing a reduced beach nourishment length.

Since the project reach is shortened, the upcoast (east) fill area will not provide as much feeder material to the downcoast (west) beach area fronting the WWRF. Therefore, the frequency of renourishment may need to be increased. This alternative requires approximately 145,000 cy of initial beach fill to create an 80-foot beach berm. Approximately 55,000 cy would be required every 8 years to renourishment and maintain the project design width. Figure 20 provides a cross-section illustration of the beach fill at the site and Figure 21 provides a plan view of the project reach for both beach nourishment alternatives.

3. Sand Sources

Moberly and Chamberlain (1964) conducted sand samples analyses on various Hawaiian beaches. The sands from the Kahului to Sprecklesville area were almost entirely carbonate. Mechanical analyses were made of sand samples taken from the berm and approximate sea level. At the beach adjacent to the east breakwater at Kahului Harbor, the grain size was found to be 0.2-0.5 mm at the berm and 0.3-1.0 mm at sea level. The median diameter of Maui's Windward beaches had a median diameter of 0.18 mm. They concluded that finer-grained sediments were found on the windward coasts of all of the islands analyzed; however, the authors found that Maui's beach sands were typically finer than sands found on the other Hawaiian Islands.

There are several known inland sources of sand for construction of a beach nourishment project. Maui dune sand is relatively fine sand that is found in the upland areas and is used for dune and minor beach fills. Typically, fine-grained sediments are not ideal for high-energy beaches, such as the Kahului Beach area. Bodge (1999) stated the Honokowai Beach Park site, the upland dune material exhibited a 45% overfill requirement. There is an inland dune quarry that has been used for source material located in Happy Valley, approximately 10 miles from Sugar Cove (Guild 1999). The inland sand mines on Maui have historically charged between $10 and $18 per cubic yard. However, on other islands, the cost has ranged from $25 to $60 per cubic yard (Honolulu Advertiser, September 9, 2004).

For this analysis, a cost of $25 per cubic yard was assumed for the sand material, but whether inland, offshore, or a combination of sources is not defined. It is noted, however, that the costs for inland sources may increase substantially due to the large volume required to construct Alternatives 1A or 1B. These large volumes will likely make the use of inland source material cost-prohibitive. Ultimately, offshore borrow areas may be less costly for a beach nourishment project requiring large volumes.

Using offshore borrow areas involves dredging the sandy material and pumping it to the shore. The Waikiki demonstration project will be the first major pumping operation of its kind in the Islands, and could be a prime example for slowing beach erosion across the state (Honolulu Advertiser, September 9, 2004). Maui's Beach Management Plan (University of Hawaii Sea Grant Extension Service and County of Maui Planning Department 1997) recommends that a pilot project for beach nourishment is "very much needed." This plan also states that in order to ensure a successful pilot beach nourishment project, a site-specific, coastal engineering study would be needed.

B. Alternative 2 - Beach Nourishment Augmented with Sand Retention Structures (T-Groins)

This alternative includes constructing seven sand retention structures (groins) along the 2,640-foot project reach and filling the area with sandy material. The groins replicate natural sand barriers, such as headlands and smaller rock outcroppings, blocking the longshore transport and "trap" the sand in the pockets between the structures. Therefore, the initial fill volume and renourishment volume and frequency are decreased compared to conventional beach nourishment.

Approximately 40,000 tons of quarried rock is required to construct the groin system and approximately 130,000 cy of sand is required for the initial beach fill. Renourishment is proposed every 10 years with approximately 40,000 cy of sand to maintain the design profile within the project area. This alternative provides added longevity to the beach fill and provides better public access than a revetment alone. Figure 22 and Figure 23 illustrate the groins and beach fill.

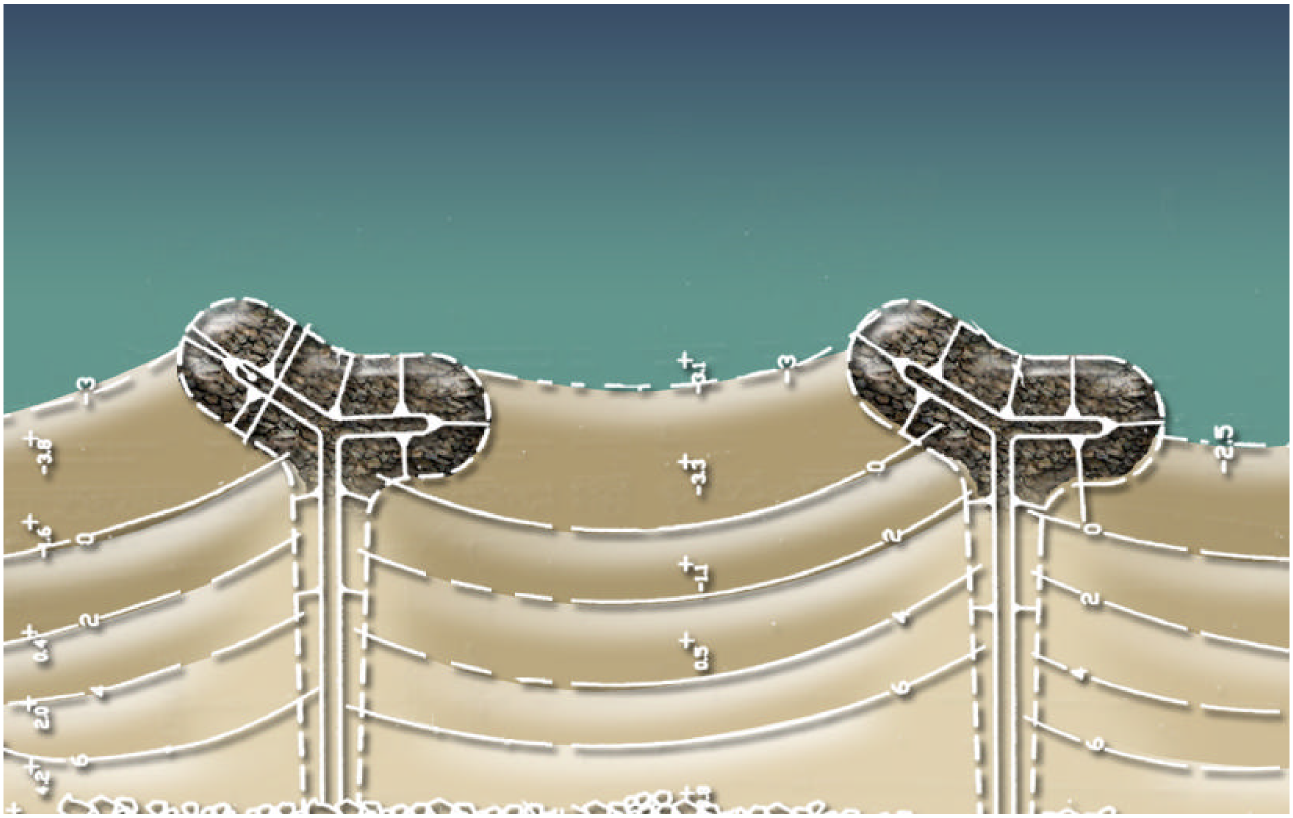


Figure 22. Details of the T-Groin Structure

1. Sources of Armor and Nourishment Material

Both inland quarries and inland boulder fields are typically used for acquiring armor stone for beach protection structures. The inland boulders are typically located in the sugar cane fields and are found from the preparation of the soil for planting and/or harvesting.

The beach nourishment material may be acquired from inland and/or offshore sand sources, as described in Section VIII A.3. For this study, we estimate a cost of $75 per ton for the large armor stone, $65 per ton for the under layer rock, and $25 per cubic yard for the nourishment material.

Figure 23. Plan view of site with T-Groins and Beach Nourishment.

C. Alternative 3 - Armor Rock Revetment

Hard structures, such as revetments and seawalls, can provide shoreline protection as a last line of defense from coastal erosion resulting from storm wave attack, storm- and tsunami-induced erosion, and long-term shoreline retreat. Without the structures, the beach would continue to erode and threaten the upland area. Typically, hard structures are not as acceptable to the public or regulatory agencies as soft structures, such as beach nourishment. At the WWRF site, the existing revetment could be extended along the property to provide upland protection from severe erosion and storm events. The east flank of the existing revetment may need to be extended or revised to minimize further flanking.

1. Alternative 3A – Revetment Extension

The USACE constructed the original 450-foot revetment in 1979 for a total cost of approximately $300,000 with federal and non-federal funds. For this alternative, the revetment would be extended to the west along the WWRF property length, a distance of approximately 1,200 feet, and would require approximately 14,000 tons of armor and under layer rock. The revetment would be constructed along the back portion of the beach, close to the existing fence line, and would be a similar design to the existing revetment. The existing beach material that was removed to construct the revetment would be replaced over the structure, but no further sand would be added to the system. Figure 24 and Figure 25 illustrate the plan view and cross-section of the revetment alternative.

2. Alternative 3B – Buried Revetment

This alternative includes adding beach nourishment with the revetment to provide a recreational beach area and to minimize impacts to littoral transport and adjacent beaches. The revetment would remain buried and would retain a last line of defense for protection of the WWRF in the event of severe erosion caused by storms or tsunami. A decreased beach width is proposed, since it is not necessary to provide protection from the seasonal fluctuations as the revetment will protect the property in the absence of any sand. Normal seasonal accretion in front of the revetment will be encouraged such that the revetment remains covered the bulk of the time. With proper planning of the revetment location and periodic beach nourishment maintenance, the seasonal erosion and accretion will occur naturally in front of the revetment.

This alternative includes approximately 75,000 cy of initial beach fill, creating a 50-foot beach berm. The beach nourishment extends along the entire length of the proposed and existing revetment and to the east for an additional 500 feet. The total project length is approximately 2,150 feet. Approximately 30,000 cy of renourishment is required every eight years to maintain the project design width. The profile would be similar to Figure 25, but would be buried by the nourishment material. Sources for the armor and nourishment material are discussed in Sections VIII A.3 and VIII B.1, above.

Figure 24. Plan view of Revetment Alternative

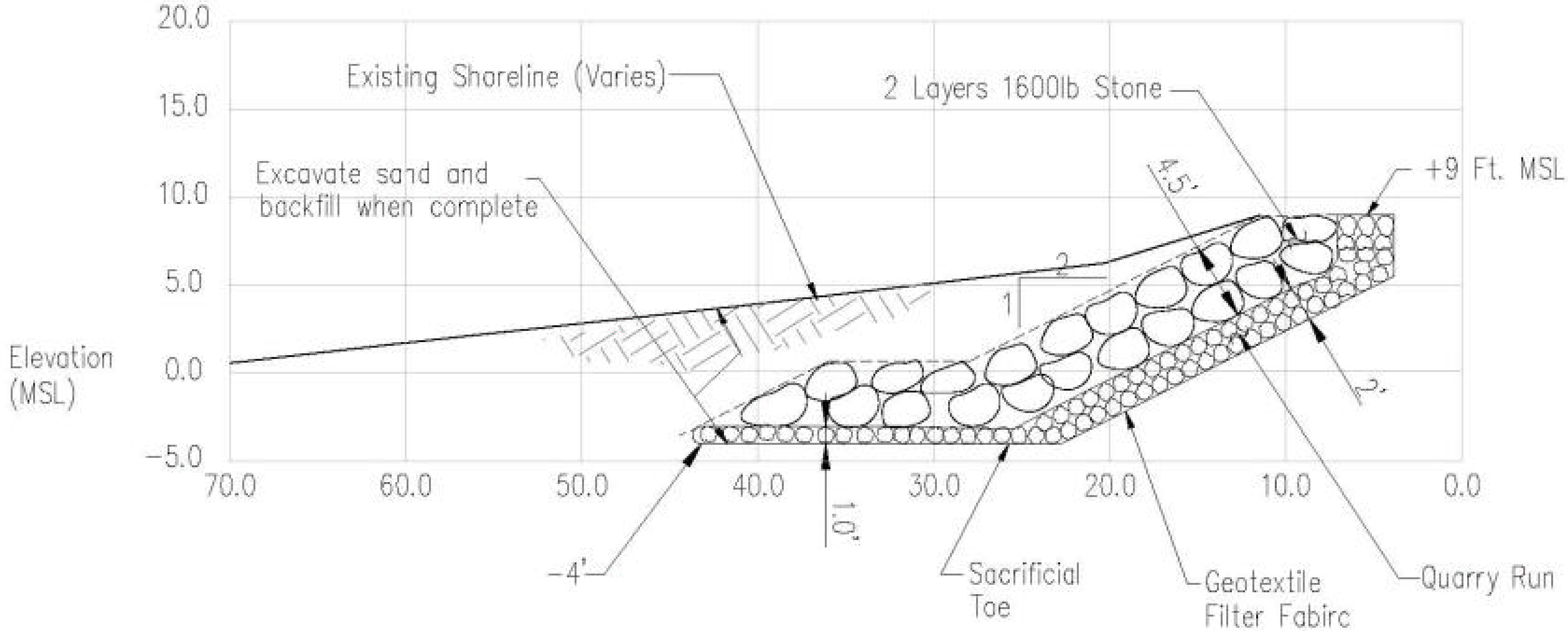


Figure 25. Typical Revetment Cross-Section

D. Other Alternatives

1. Coral Rubble Fill

Use of cobble as beach nourishment is not typical along most areas of the U.S. The practice has achieved wider acceptance in Europe. There have been some small-scale projects constructed in Southern California along reaches where the beach is naturally composed of cobble. A photograph of a cobble beach nourishment project in Southern California is provided in Figure 26. Applying a similar project to the WWRF property would include using coral rubble as the fill material. This would potentially provide a more stable beach than using sand, since the coral rubble is heavier and less subject to longshore transport. Overtime, the coral would break apart by the wave action and create a sandy surface.

The County had historically used coral rubble as road base material until this practice was discouraged since the rubble is littoral material and should remain in the littoral zone. Sources for such a coral rubble fill are not extensively known, although accumulations of this material can be observed along many of Maui's shorelines.

Due to the severity of the erosion at the WWRF and the high importance of the recreational beach use and reclamation facility to Maui residents, this type of project may not be practical and conventional methods are probably preferred.

2. Vertical Seawall and Hybrid Structure

Because the site is already protected by an armor stone revetment and because of the relatively limited public use of the beach fronting the property, a vertical seawall is not considered further. It is our experience this type of structure is significantly more expensive and is more beneficial in areas where the public benefits of retaining beach space far outweighs the costs of construction and maintenance.

Figure 26. Picture of a cobble nourishment project, City of Ventura in Southern California.

E. Potential Environmental Impacts

Potential impacts from construction of any of the alternatives may include temporary and permanent impacts. Temporary impacts include traffic congestion from trucking sand or armor to the beach; air quality impacts from the trucking, construction equipment, and dredge equipment; and turbidity impacts during placement of sand.

Permanent impacts from construction of a shore protection project include increased sedimentation at Kahului Harbor, impacts to adjacent shorelines, biological impacts (reefs), and impacts to public access. Precautions would be taken to prevent eroded soils, construction debris, and other contaminants from entering the coastal waters. Increased sedimentation at Kahului Harbor may occur from the placement of large quantities of beach fill along the reach east of the harbor. This may require more frequent maintenance dredging to maintain the design depth in the harbor.

Surrounding beaches may benefit from the placement of sand as the sand disperses and longshore transport carries the sand up- and downcoast. However, careful design and modeling may be necessary prior to implementation of any beach fill alternative to ensure the fill material does not migrate significantly offshore, burying the reefs along the project coast.

Impacts to adjacent beaches from the construction of a revetment or shore-parallel structures, such as seawalls, are the subject of much controversy. Most science indicates such structures do not negatively impact adjacent shorelines, unless they prevent erosion of an upland source of sand for a beach downdrift or are so situated that they act as a groin. Revetments and seawalls are usually constructed on eroding beaches to protect the upland property. They are also constructed in some cases on stable beaches, providing as needed protection against short-term storm-induced erosion. The former is the case for this project. Maui's north coast is actively eroding and will continue to erode under natural conditions.

Beach nourishment provides better public access than hard structures, such as the groin system and revetment. However, the groin system does provide more sand retention, requiring less volume of initial sand and less frequent renourishment. The revetment will provide a last-line of defense to the facility if a major storm or tsunami occurs. Beach nourishment alone will probably not provide the same protection to the facility.

Monitoring will be required for any alternative constructed at the site and may include beach profiling, grain size analysis, project performance, and any observable adverse water quality impacts.

F. Regulatory Requirements

The State of Hawaii and County of Maui are the local regulatory agencies for permitting shore protection structures. The main regulations pertaining to shore protection include the Hawaii Revised Statutes Chapter 205-A, Coastal Zone Management, and the Shoreline Rules for the Maui Planning Commission.

In general, the State and County will not approve any shore protection (except sand placement) unless a structure is imminently threatened. An imminent threat means the structure is within the shoreline setback area. At the WWRF facility, the shoreline setback line is approximately 134 feet from the chain link fence on the northern boundary of the property. Some of the WWRF structures are located within this setback area.

If a structure is within the shoreline setback area and is not under an emergency situation, then the County proceeds in its regular process of building a new structure in the Special Management Area (SMA). The first item the County considers is if the structures can be relocated. In the case of the WWRF, some structures may be relocated, but most of the large process areas cannot be relocated because of limited area at the site. Since many of the structures at the WWRF cannot be relocated, County regulators may require a long-term commitment to beach replenishment program be implemented and also provide safe lateral public access along the shoreline. This can either be a walkway on or near the revetment or beach area for the public.

In general, the State will not allow hard structures to be placed within its jurisdiction, so most applications for hard structures will be permitted under the County SMA, and will need to be placed entirely within the boundaries of the property owner (landward of the shoreline). In order to acquire a variance from the County to construct a hard structure, an Environmental Assessment, public notice, and a public hearing will need to be conducted. A variance can be approved for improvements proposed by public agencies or public utilities regulated under Hawaii Revised Statutes (HRS) Chapter 269. The Wailuku-Kahului Wastewater Reclamation Facility is a County-owned pubic utility regulated under this statute

G. Cost Estimates

Costs for each of the alternatives were estimated based on both, Present Value and Annualized costs for both the construction and maintenance cycle. Each alternative has a 50-year design life. A more detailed cost estimate for each alternative is provided in Appendix B.

Present Value Costs calculate the initial construction and future maintenance costs based on current value dollars. The maintenance costs were inflated for each maintenance cycle to address inflation, future labor rates, future construction costs, etc. It is assumed that this inflation is a simple interest of 2.3% based on the Engineering News Record Construction Cost Index since 1977. For each maintenance cycle, the maintenance costs were then translated to present-value dollars assuming a 7.13% rate of return

Table 5 outlines the Present Value total cost for construction and future maintenance for each alternative for the WWRF. Alternative 1A, 4,000-foot long beach nourishment, has the highest cost at approximately $10 million, because of the large volume of sand needed to construct the project. The decreased length beach nourishment alternative (1B) is less expensive ($7.4 million), however, does require more frequent renourishment to maintain the design beach width. The nourishment with groin system is the third most expensive alternative ($9.8 million), mainly due to the large amount of armor stone that would be required to construct the groins. Both of the revetment alternatives are the least expensive ($1.6 million and $4.4 million). However, it is noted the buried revetment does provide additional recreational and aesthetic benefits over the revetment alone.

Table 5. Approximate Present-Value Cost Estimates for the WWRF Alternatives

Alternative		***Total Cost***
1A	Beach Nourishment (4,000 ft project length)	$10,200,000
1B	Beach Nourishment (2,650 ft project length)	$7,400,000
2	Beach Nourishment with Groin System (2,640 ft project length)	$9,800,000
3A	Revetment (1,200 ft project length)	$1,600,000
3B	Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)	$5,400,000

Annualized Costs calculate the annual cost of each alternative over the life cycle of the project (50-years). Annualized Construction Costs indicate the annual value of the initial construction costs over a 50-year life cycle. Whereas, the Annualized Maintenance Costs indicate the annual cost needed to conduct the future maintenance over the 50-year life cycle. The rate of return used in the Annualized Costs is 7.13%. The table below outlines the construction, maintenance, and total annualized cost for each alternative.

As shown in Table 6, Alternative 1A has the highest annualized total cost of approximately $724,000 per year for 50-years. Alternatives 1B and 2 have the next highest annualized total costs ($553,000 and $609,000 per year, respectively). The revetment and buried revetment have the two lowest annualized costs ($87,400 and $118,000 per year, respectively). However, it is again noted that the buried revetment does provide additional benefits over the revetment alone.

Table 6. Approximate Annualized Cost Estimates for the WWRF Alternatives

Alternative		*Annualized Construction Cost **	*Annualized Maintenance Cost **	*Total Annualized Cost **
1A	Beach Nourishment (4,000 ft project length)	$400,000	$324,000	$724,000
1B	Beach Nourishment (2,650 ft project length)	$271,000	$282,000	$553,000
2	Beach Nourishment with Groin System (2,640 ft project length)	$459,000	$150,000	$609,000
3A	Revetment (1,200 ft project length)	$82,000	$5,400	$87,400
3B	Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)	$82,000	$36,000	$118,000
**Costs represent dollars per year ($/yr) for a 50-year life cycle.*				

IX. POTENTIAL PROJECT ALTERNATIVES AT THE WWPS

The WWPS site is a small lot located to the west of Kahului Harbor with a beach front width of approximately 150 feet. This section describes alternatives that could be constructed at the WWPS site to minimize future scour and erosion from severe storms. Each of these alternatives only provides protection for the 150-foot property width. However, further scour erosion would occur up- and down-coast of the property unless they are also protected. If only the WWPS property is protected, then careful design of the flanking areas needs to be considered to minimize impacts from erosion occurring around the ends of the protective structure. Since this site is not generally accessed by the public, hard structures may be more amenable by the public and regulatory agencies.

A. Alternative 1 - New Revetment

This alternative includes removing the rubble fronting the site and replacing it with a new engineered revetment. Initial estimates assume the same cross-section as the revetment fronting the WWRF, as shown in Figure 25. The site would be graded and a layer of filter fabric placed under the proposed revetment. Approximately 1,800 tons of armor and under layer rock are required for construction of the 150-foot long revetment. The filter fabric and engineered design provide adequate protection from future storm surge and requires minimal maintenance over the project life.

B. Alternative 2 - Repair Rubble Revetment

It does not appear the existing rubble at the site was placed in any engineered configuration, but rather just randomly dumped. This alternative includes repairing and replacing the existing rubble at the site to provide better protection from severe storms. Placement of filter fabric is not proposed for this alternative, but the general cross-section would be similar to the revetment shown in Figure 25. Some grading is proposed and it is estimated a portion of the existing rubble may be reused at the site, but at least half of the volume needed would be brought in from outside sources. It is estimated that approximately 1,700 tons of rubble would be required in addition to the material available at the site. Future storms may cause the rubble to move and resettle and would require more frequent maintenance after storm events.

C. Other Alternatives

1. Seawall

A seawall is another alternative that could be constructed for shore protection. Typically, seawalls are constructed to minimize encroachment onto the beach system and minimize impacts to recreational beach users. However, since this site is fronted by a rubble mound, public access is currently restricted. Also, the cost for seawall construction compared to a revetment is much greater and at this site the benefits are minimal. Therefore, a seawall at the WWPS site is not considered further.

2. Beach Nourishment

A beach nourishment project could also be constructed at the WWPS. However, this shoreline currently consists of a cobble, rock, and rubble foreshore and a large volume of sand could be required along the entire reach and not just fronting the WWPS property. The entire reach from the Kahului west jetty to the adjacent armoring structure to the north would need to be filled to provide adequate protection. If a sandy beach were constructed just on the shore immediately fronting the WWPS, the fill material would disperse up- and downcoast, and offshore and the WWPS would be threatened again. It is also noted the major threat at this site appears to be from sever storm events and not recent erosion trends.

D. Cost Estimates

Costs for each alternative at the WWPS were estimated based on both, Present Value and Annualized costs for both the construction and maintenance cycle. Each alternative has a 50-year design life. A more detailed cost estimate for each alternative is provided in Appendix B.

Present Value Costs calculate the initial construction and future maintenance costs based on current value dollars as discussed in Section VIII.G. Table 7 outlines the total cost for construction and future maintenance for each alternative for the WWPS. Alternative 1 is the newly engineered revetment and has a slightly higher cost than Alternative 2, repair of existing rubble revetment ($260,000 vs. $205,000, respectively). Although the initial construction cost for Alternative 1 is higher, the maintenance cost for Alternative 2 is much higher than Alternative 1. It is noted the new engineered revetment provides better protection from severe storm surges. A more detailed cost estimate for each alternative is provided in Appendix B.

Table 7. Approximate Present-Value Cost estimates for the WWPS Alternatives

Alternative		***Total Cost***
1	Revetment (150 ft project length)	$260,000
2	Repair Rubble Revetment (150 ft project length)	$205,000

Annualized Costs calculate the annual cost of each alternative over the life cycle of the project (50-years) as discussed in Section VIII.G. Table 8 shows that Alternative 1 has a slightly higher annualized cost than Alternative 2 ($14,400 and $11,800 per year for 50 years, respectively). As stated above, the new engineered revetment (Alternative 1) does provide better storm protection compared to the rubble repair (Alternative 2).

Table 8. Approximate Annualized Cost Estimates for the WWRF Alternatives

Alternative		***Annualized Construction Cost ****	***Annualized Maintenance Cost ****	***Total Annualized Cost ****
1	Revetment (150 ft project length)	$13,400	$1,000	$14,400
2	Repair Rubble Revetment (150 ft project length)	$9,300	$2,500	$11,800
**Costs represent dollars per year ($/yr) for a 50-year life cycle.*				

X. RANKING CRITERIA

This section discusses the various ranking criteria used to evaluate each of the alternatives described in Sections VIII and IX. The evaluation criteria include:

- Construction Cost – Initial costs for construction of the alternative
- Maintenance Cost – Life-cycle costs for maintenance of the alternative
- Public Access and Usage – Affects to public beach access and recreational use
- Design Life – Offers best protection over design life
- Regulatory Compliance – Best meets regulatory regulations
- Aesthetics – Effects to the aesthetics of the existing area
- Impacts to Kahului Harbor – Increased frequency of dredging at Kahului Harbor or other adverse impacts
- Environmental Impacts to Biology – Impacts to biological resources in the area
- Environmental Impacts to Adjacent Shoreline – Impacts to adjacent shoreline areas

These alternatives were evaluated to determine a weighted value for each. Some criteria are more important than others in evaluating the alternatives and should be weighted more than other less-important criteria. Table 9 shows the criteria and the weighted value assigned to each.

Environmental impacts to both biology and adjacent shorelines received the highest rank. This is because it is extremely difficult and costly to mitigate for biological impacts if any were caused by the shore protection alternative. Impacts to Kahului Harbor are slightly less important than the environmental impacts, because the main cause of any impact is sedimentation at the harbor, which would increase the maintenance dredging cycle, but not cause any long-term negative impact. Design life is slightly more important than construction and maintenance cost to ensure that the quality of the alternative in providing protection is cost effective.

Regulatory compliance received a lower score than the previous criteria, not because it is not important to comply with the regulations, but because these sites are part of a public utility and variances are generally more permissible than at private locations and many existing structures at the sites are already located within the shoreline setback line. Public access and usage and aesthetics received the lowest score mainly because these sites are not a heavily used site by the public. The beaches to the east of the WWRF are used by the locals and wind surfing or kite surfing community.

Table 9. Weighted Value of Evaluation Criteria

Criteria	Weighted Value
Construction Cost	21
Maintenance Cost	21
Public Access and Usage	16
Design Life	24
Regulatory Compliance	19
Aesthetics	17
Impacts to Kahului Harbor	28
Environmental Impacts - Biology	35
Environmental Impacts - Adj shorelines	35

Each alternative was evaluated based on the criteria listed above. A value of 1 through 5 was assigned to each criteria evaluation for each alternative. A 5 represents the best value for the criteria and a 1 is the poorest value. Then a weighted score is calculated by multiplying the value assigned to the criteria and the weighted value of each criteria. For each alternative, the total scores are summed to determine a ranking of alternatives. The alternative with the highest score is the preferred alternative based on the evaluating criteria.

The following tables show the weight value of each criteria in *italics* under each criteria heading. For each alternative, the value assigned to each criteria is shown in the gray box, and the score calculated for each criteria is in bold.

The total score column of the tables indicates the preferred alternative at the WWRF and WWPS are the Buried Revetment and New Engineered Revetment, respectively.

Table 10. WWRF Alternative Evaluation

	Construction Cost		Maintenance Cost		Public Access & Usage		Design Life		Regulatory Compliance		Aesthetics		Impacts to Kahului Harbor		Environmental Impacts to Biology		Environmental Impacts to Adjacent Shorelines		TOTAL SCORE	RANK
Criteria Weighted Value	*21*		*21*		*16*		*24*		*19*		*17*		*28*		*35*		*35*			
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score		
ALT 1A- 4000-FT BEACH FILL	2	**42**	1	**21**	5	**80**	2	**48**	5	**95**	5	**85**	2	**56**	2	**70**	5	**175**	**672**	3
ALT 1B- 2500-FT BEACH FILL	3	**63**	2	**42**	4	**64**	1	**24**	5	**95**	4	**68**	2	**56**	2	**70**	4	**140**	**622**	5
ALT 2- BEACH FILL W/ GROINS	1	**21**	3	**63**	3	**48**	3	**72**	3	**57**	3	**51**	4	**112**	3	**105**	3	**105**	**634**	4
ALT 3A- REVETMENT	5	**105**	5	**105**	1	**16**	5	**120**	1	**19**	2	**34**	5	**140**	4	**140**	2	**70**	**749**	2
ALT 3B- BURIED REVETMENT	4	**84**	3	**63**	4	**64**	4	**96**	4	**76**	4	**68**	3	**84**	3	**105**	4	**140**	**780**	1

Table 11. WWPS Alternative Evaluation

	Construction Cost		Maintenance Cost		Public Access & Usage		Design Life		Regulatory Compliance		Aesthetics		Impacts to Kahului Harbor		Environmental Impacts to Biology		Environmental Impacts to Adjacent Shorelines		TOTAL SCORE	RANK
Criteria Weighted Value	*21*		*21*		*16*		*24*		*19*		*17*		*28*		*35*		*35*			
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score		
ALT 1- NEW REVETMENT	3	**63**	4	**84**	2	**32**	4	**96**	2	**38**	3	**51**	3	**84**	3	**105**	3	**105**	**658**	1
ALT 2- RUBBLE REPAIR	4	**84**	2	**42**	2	**32**	2	**48**	2	**38**	2	**34**	3	**84**	3	**105**	3	**105**	**572**	2

XI. SUMMARY AND CONCLUSIONS

A. Wailuku-Kahului WWRF

Evaluation of the available shoreline data indicates the rate of recession was highest from 1960 to 1975 and from 1975 to 1987. The rate of shoreline recession has since decreased and shoreline advance has occurred in some areas along the study reach. However, immediately west of the revetment at the WWRF, the rate of shoreline recession from 1997 to 2002 indicates a strong (up to 6 feet per year) rate of shoreline recession.

Using this maximum shoreline recession rate, it is estimated that some structures at the facility may be threatened in as little as two to three years. However, some of these early-threatened structures can be relocated to other areas on the WWRF property. The first major structure that would be threatened is the Effluent Meter at the end of the Chlorine Contact Tank. This structure may be threatened in as little as 14 years. For average recession conditions, this structure may be threatened in approximately 26 years. It is noted, this erosion rate is an average of recent conditions, and significant storms can accelerate and localize the erosion in the area.

Methods to provide protection to the WWRF site include beach nourishment and construction of revetment. Preliminary alternatives described in this study include beach nourishment with compatible sand material, beach nourishment with retention structures, continuing the revetment along the property, and a combination of a revetment extension and beach nourishment.

Evaluation of the alternatives indicates the preferred alternative is the buried revetment. This alternative provides a last line of defense against severe storms and tsunamis and also provides a recreational beach area which is more amenable to the general public and regulatory agencies. A long-term commitment must be made to ensure future funding for maintenance of the beach fill.

B. Wailuku WWPS

Analysis of the available shoreline data indicates that this area has exhibited slight recession. The most recent trends from 1997 to 2002 indicate that the shoreline has been fairly stable. This is most probably due to the fact that properties have been armored or the beach face area is rocky, halting further shoreline recession.

The WWPS shoreline is naturally protected by a rubble beach from further short-term erosion. Any further damage to the upland areas will be caused by severe storms (elevated water levels and subsequent wave attack) and tsunami. The upland property will continue to fail and erode during large storms unless it is protected.

This site appears to be fairly easy and acceptable to construct a revetment within the existing rubble footprint, because of the large amounts of rubble and boulders already existing along the reach and limited public use. Evaluation of the alternatives indicates that the preferred alternative is a new engineered revetment. This alternative provides a last line of defense against severe storms and tsunamis without degrading the rubble beach further.

C. Recommended Future Studies

Future recommended studies include a sediment budget analysis of the Kahului region and investigation study of potential offshore sand sources.

1. Sediment Budget Analysis

A more-detailed study is required to better understand the physical processes of the shoreline, as well as determine the efficacy of the alternatives presented in this report. A sediment budget analysis should be considered as the next step for Maui's north coast to better identify and quantify specific causes of the erosion problem. A sediment budget analysis is a continuity exercise to quantify fluxes of sediment into and out of a specific control volume. The budget is developed to (1) estimate the incoming and outgoing volumes of sediment to the extent possible with the existing information; (2) sum all losses and gains; (3) compare the results with measured changes in volume within the control volume; and (4) use judgment and perhaps additional data to adjust the fluxes until they best balance. The goal for a sediment budget analysis at the Kahului beach areas is to estimate the amount of sand available in the system, identify and quantify the major fluxes of sediment that can affect the shoreline, estimate changes in them before and after various natural and man-induced impacts occurred, and identify those changes that are considered reversible due to shore protection.

Specific elements of the sediment budget analysis should include:

- An assessment of the amount of sand within the littoral system based on field observations including jet probing
- Wind transport analysis using improved predictive models that can be calibrated with field measurements
- Estimate past, present and potential future rates of sand production from the fringing reef system
- More information on the shoreline evolution after construction of Kahului Harbor
- Sand transport through the reef system and around Kahului Harbor
- Sand transport/sedimentation within Kahului Harbor

2. Investigation of Offshore Sand Sources

A study investigating the potential of offshore sand sources should be conducted. The use of inland sand sources is viable for small-scale projects; however, it may be economically unfeasible for large-scale nourishment projects.

This study has been recommended by other interested parties in the Hawaiian Islands. University of Hawaii Sea Grant Extension Service and County of Maui Planning Department prepared a Beach Management Plan for Maui (1997). The plan recommends potential offshore borrow sites be identified, mapped, and sampled. The plan also recommends funding for the offshore sand resource studies could be shared by Maui County, DLNR, the University of Hawaii, and the U.S. Army Corps of Engineers.

Further, this Beach Management Plan recommends conducting a pilot project for beach nourishment on Maui to illustrate the engineering requirements, permitting requirements, problems and concerns.

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APPENDIX A

SITE PHOTOGRAPHS OF THE SHORELINE FRONTING THE WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY AND THE WAILUKU WASTEWATER PUMP STATION

JULY 16, 2004


Photo 1. East flank of the revetment fronting the Wailuku-Kahului WWRF.


Photo 2. Looking East from the revetment at the W-K WWRF.
(Notice the old “pill box” offshore.)


Photo 3. Looking West towards the W-K WWRF revetment.


Photo 4. Looking West from the crest of the revetment towards Kahului Harbor.

Photo 5. Looking East from the Revetment. (Notice the old "pill box" offshore.)

Photo 6. Looking West from the cre st of the revetment towards Kahului Harbor.

Photo 7. Looking West from the revetment towards Kahului Harbor.

Photo 8. Looking East towards the revetment.

Photo 9. West of the WWRF property, looking West at remnants of an old groin. Kahului Harbor is seen in the background.

Photo 10. Remnants of an old groin (same location as above).

Photo 11. Shoreline looking northwest towards the WWPS.

Photo 12. Shoreline looking southeast towards Kahului Harbor.

Photo 13. Large escarpment fronting the WWPS property (fence).

Photo 14. Looking Southeast along WWPS property line towards Kahului Harbor.

Photo 15. Wailuku WWPS facilities.

Photo 16. Shoreline fronting the WWPS, looking southeast.


Photo 17. Exposed drainage pipe at the WWPS.


Photo 18. Escarpment and shoreline looking northwest from WWPS.
(notice large seawall fronting property to the north.)

APPENDIX B – COST ESTIMATE DETAILS

WWRF ALTERNATIVES

Alternative 1A - Beach Nourishment (4,000 ft project length)

			Unit Cost	**Cost**
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Fill material	215,000	CY	$25	$5,375,000
			Initial Construction Subtotal	$5,425,000
Present Construction Rate Maintenance Costs	86,000	CY	$25	$2,150,000
- 40% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$2,644,500	$1,328,105
20			$3,139,000	$791,716
30			$3,633,500	$460,248
40			$4,128,000	$262,600
			Subtotal	$8,267,670
			Supervision and Administration (6%)	$325,500
			Engineering & Design (10%)	$542,500
			Contingency (20%)	$1,085,000
			TOTAL	**$10,220,670**

Alternative 1B - Beach Nourishment (2,650 ft project length)

			Unit Cost	**Cost**
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Fill material	145,000	CY	$25	$3,625,000
			Initial Construction Subtotal	$3,675,000
Present Construction Rate Maintenance Costs	55,000	CY	$25	$1,375,000
- 40% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
8			$1,628,000	$938,352
16			$1,881,000	$624,901
24			$2,134,000	$408,628
32			$2,387,000	$263,449
40			$2,640,000	$167,942
			Subtotal	$6,078,272
			Supervision and Administration (6%)	$220,500
			Engineering & Design (10%)	$367,500
			Contingency (20%)	$735,000
			TOTAL	**$7,401,272**

Alternative 2 - Beach Nourishment with Groin System (2,640 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$100,000	$100,000
Armor Rock	25,050	TN	$75	$1,878,750
Underlayer Rock	14,620	TN	$65	$950,300
Fill Material	132,000	CY	$25	$3,300,000
			Initial Construction Subtotal	$6,229,050
Present Construction Rate Maintenance Costs	40,000	CY	$25	$1,000,000
- 30% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$1,230,000	$617,723
20			$1,460,000	$368,240
30			$1,690,000	$214,069
40			$1,920,000	$122,140
			Subtotal	$7,551,222
			Supervision and Administration (6%)	$373,743
			Engineering & Design (10%)	$622,905
			Contingency (20%)	$1,245,810
			TOTAL	**$9,793,680**

Alternative 3A - Revetment (1,200 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	9,000	TN	$75	$675,000
Quarry Rock	5,000	TN	$65	$325,000
Filter Fabric	12,000	SY	$5	$60,000
			Initial Construction Subtotal	$1,110,000
Present Construction Rate Maintenance Costs	1	LS	$55,500	$55,500
- 5% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$68,265	$34,284
20			$81,030	$20,437
30			$93,795	$11,881
40			$106,560	$6,779
			Subtotal	$1,183,381
			Supervision and Administration (6%)	$66,600
			Engineering & Design (10%)	$111,000
			Contingency (20%)	$222,000
			TOTAL	**$1,582,981**

Alternative 3B - Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)

			Unit Cost	**Cost**
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	9,000	TN	$75	$675,000
Quarry Rock	5,000	TN	$65	$325,000
Filter Fabric	12,000	SY	$5	$60,000
Fill Material	75,000	CY	$25	$1,875,000
			Initial Construction Subtotal	$2,985,000
Present Construction Rate Maintenance Costs				
Fill Material	30,000	CY	$25	$750,000
- 40% of original volume every 8 years				
Revetment	1	LS	$55,500	$55,500
- 5% of original cost every 20 years				
Project Year			Future Inflated Cost	Present Worth
8			$888,000	$511,828
16			$1,026,000	$340,855
20			$81,030	$20,437
24			$1,164,000	$222,888
32			$1,302,000	$143,700
40			$1,546,560	$98,384
			Subtotal	$4,323,091
			Supervision and Administration (6%)	$179,100
			Engineering & Design (10%)	$298,500
			Contingency (20%)	$597,000
			TOTAL	**$5,397,691**

WWPS ALTERNATIVES

Alternative 1 - Revetment (150 ft project length)

			Unit Cost	**Cost**
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	1,125	TN	$75	$84,375
Quarry Rock	625	TN	$65	$40,625
Filter Fabric	1,500	SY	$5	$7,500
			Initial Construction Subtotal	$182,500
Present Construction Rate Maintenance Costs	1	LS	$10,000	$10,000
- 5% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$12,300	$6,177
20			$14,600	$3,682
30			$16,900	$2,141
40			$19,200	$1,221
			Subtotal	$195,722
			Supervision and Administration (6%)	$10,950
			Engineering & Design (10%)	$18,250
			Contingency (20%)	$36,500
			TOTAL	**$261,422**

Notes:

1) Armor rock was calculated based on the tons per linear foot for WWRF alternative and applying this to the 150-ft project length at the WWRF

2) Maintenance frequency and amount is est engineers estimate

Alternative 2 - Repair Rubble Revetment (150 ft project length)

			Unit Cost	**Cost**
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Rubble	1,700	TN	$45	$76,500
			Initial Construction Subtotal	$126,500
Present Construction Rate Maintenance Costs	1	LS	$25,300	$25,300
- 15% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$31,119	$15,628
20			$36,938	$9,316
30			$42,757	$5,416
40			$48,576	$3,090
			Subtotal	$159,951
			Supervision and Administration (6%)	$7,590
			Engineering & Design (10%)	$12,650
			Contingency (20%)	$25,300
			TOTAL	**$205,491**

Notes:

1) Assume the same amount of rubble (tons) is needed to repair the rubble revetment as was required for the design of the new revetment

2) Assume a cost of $45/ton for rubble. Some existing rubble can be reused and other rubble may have to be imported. The cost is an estimate based on engineering judgment

3) Maintenance assumes that more maintenance will be required of the rubble structure since it is not engineered. Storms will shift the rubble more frequently and require more frequent maintenance to ensure upland protection

APPENDIX F

TSUNAMI STUDY AT THE CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

TSUNAMI STUDY

at the

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

KAHULUI, MAUI, HAWAII

EXECUTIVE SUMMARY

I. PURPOSE

Nagamine Okawa Engineers Inc. was tasked to assess the effects of the tsunami wave forces on the structural integrity of the selected structures at the Central Maui Wastewater Reclamation Facility, at Kahului, Maui, Hawaii. Analysis of the structures is based on the overall stability of the selected buildings, and structural integrity of the individual exterior members facing the ocean, due to scouring, and buoyant, hydrostatic, drag and impact forces, from the 100-year tsunami wave force of height measuring 20.1 feet from the MSL.

Central Maui Wastewater Reclamation Facility is located on the north side of Kanaha Bird Sanctuary, and bounded by Amala Place and Kahului Bay.

II. DISCUSSION

The following buildings/structures were analyzed for overall stability against overturning, sliding, flotation, undermining of foundation due to scour, and structural adequacy of the exterior member(s) to resist tsunami wave force:

A. The 30-ft Diameter Sludge Holding Tank

B. Operations Building with Elevated Centrifuge Platform

C. Effluent Meter Box, Filter and Chlorine Contact Tanks

D. Secondary Clarifier, Aeration Basin and Aerobic Digester

E. Headworks Building

III. CONCLUSION

Analysis revealed that in general the deficiencies due to lack of embedment of the structure foundation would result in the undermining of the foundation from scouring action at Operations Building housing the elevated Centrifuge Platform, and Headworks Building. Operations Building and Sludge Holding Tank (if not filled) would be deficient in resisting sliding at the base. Individual structural concrete members, at the exterior of the structures consisting of Effluent Meter Box, Filter and Chlorine Contact Tanks, and Headworks Building, as well as metal members of Operations Building and Headworks Building, were found to be deficient.

IV. RECOMMENDATIONS AND ESTIMATED RANGE OF REPAIR COST

Recommended repairs and estimated cost of various building and structures to be retrofitted adequate to resist design tsunami forces are summarized below:

A. Sludge Holding Tank: Increase the thickness of the tank wall to provide additional weight to resist sliding. Estimated repair cost range between $100,000 and $300,000 is considered moderate.

B. Operations Building with Elevated Centrifuge Platform: Because metal building cannot withstand the forces of tsunami, total reconstruction is the only alternative, at cost of more than $2,000,000. If loss of superstructure is operationally tolerable, construction of deep perimeter curb wall to protect the existing building foundation from scour, and concrete guardrail around the platform to protect the equipment from debris, may be considered at a cost range of $300,000 and $600,000.

C. Various Treatment Tanks and Effluent Metered Structure: Exterior wall of some of the tanks must be thickened to provide additional strength against tsunami force and the existing wall foundation must be extended deeper to resist scour action of the tsunami wave. Estimated cost range is between $300,000 and $600,000.

D. Headworks Building: Extensive modifications must be provided to correct deficiencies against sliding, undermining of the foundation and member strength. Cost of providing additional fill above the existing grade and construction of drilled piers to resist sliding, and strengthening of concrete columns, walls and elevated slab, as well as upgraded Headworks Building superstructure, with new perimeter metal siding on concrete curb wall, is estimated to be over $1,000,000.

Damages due to floating debris should be addressed during the planning stage for repairs.

TSUNAMI STUDY

at the

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY

KAHULUI, MAUI, HAWAII

I. SCOPE OF WORK

Nagamine Okawa Engineers Inc. was tasked by Austin, Tsutsumi & Associates, Inc. to assess the effects of the tsunami wave forces on the structural integrity of the selected structures at the Central Maui Wastewater Reclamation Facility, at Kahului, Maui, Hawaii. Analysis of the structures is based on the overall stability of the selected buildings, and structural integrity of the individual exterior members facing the ocean, due to scouring, and buoyant, hydrostatic, drag and impact forces, from the 100-year tsunami wave force of height measuring 20.1 feet from the MSL.

II. INTRODUCTION

Central Maui Wastewater Reclamation Facility is located on the north side of Kanaha Bird Sanctuary, near the Kahului Airport, and bounded by Amala Place and Kahului Bay. A berm running along the shoreline to the maximum height of 15 feet partially protects the facility, that is located in the area between 140 to 260 feet from the shoreline, with grade between +6 and +10. Majority of the existing structures was constructed in early 1970's.

Overall and individual member dimensions, structural member sizes, reinforcing steel sizes and spacings, and material strengths were taken from the as-built structural drawings from the Wailuku-Kahului Wastewater Reclamation Facilities, prepared by Chung Dho Ahn & Associates, Inc.

Publications: Uniform Building Code 1997, "Foundation Investigation Wailuku-Kahului Wastewater Reclamation Facilities Improvement", by Ernest Hirata & Associates, Inc., dated May 3, 1990, "Final Report, Tsunami Flood Impact Analysis, County of Maui Wastewater Facilities Wailuku", by Edward K. Noda and Associates, Inc., dated September 1991, "Article 11. Regulations Within Flood Hazard Districts and Development Adjacent to Drainage Facilities", of the Revised Ordinance of Honolulu, Ed 1990, and "Design and Construction Standards for Residential Construction in Tsunami Prone Areas in Hawaii", January 31, 1980, by Dames and Moore, were used as references for analysis and preparation of the report.

Site investigation was conducted on August 26 and September 30, 2004, by two engineers from Nagamine Okawa Engineers Inc., to verify the existing conditions and dimensions, indicated on the as-built plans.

III. DESCRIPTION OF STRUCTURES

A. SLUDGE HOLDING TANK

There are two circular concrete sludge holding tanks, located side by side. Larger tank was constructed with consideration for tsunami forces, and therefore, excluded from the scope of the project. Smaller tank has 30' inside diameter. Both tanks measure 11.5 feet above surrounding pavement grade. Existing grade is at elevation +10. Wall is 8" thick concrete reinforced with a single mat vertical reinforcing steel at 9" o.c. and horizontal bars varying in spacing from 5" at the bottom to 10" at the top of the wall. An 8" thick slab on grade is reinforced radially with #4 at 12" maximum at the wall and #4 hoop at 12". The top of the slab is embedded about 3'-6" into the finish grade.

B. OPERATIONS BUILDING

Operations Building is a one-story pre-engineered metal building approximately 168 feet long fronting the ocean, 40 feet wide and 20 feet high at the eave, sits on a fill about 5 feet higher than the surrounding pavement. Perimeter of the building slab on grade floor has grade beam on continuous concrete footing. Gravel fill surface surrounding the building drops down about 2 feet, adjacent to the building perimeter, and slopes down toward the pavement, with a grade elevation of +10. Structural steel rigid frames are spaced between 18 and 24 feet on centers.

A 60 feet long x 30 feet wide masonry building is attached to the front (south side) side of the main pre-engineered building. Roof of the extension is wood construction.

Elevated concrete Centrifuge Platform slab, 45 feet long x 23 feet wide x 9 feet high, supported on concrete piers and beams, is located at the east end of the main building to house the generators. Individual pier footing is founded 2'-6" below finish floor at elevation +12.5.

C. EFFLUENT METER STRUCTURE, SECONDARY CLARIFIER, FILTER, CHLORINE CONTACT TANK, AERATION BASIN AND AEROBIC DIGESTER

The treatment plant structure, with various compartments and functions are connected to each other with grated walkways over the channel, with maximum length of 350 feet along the ocean front and 323 feet in north-south direction. For ease in analysis, the structure was broken down into two parts. Exterior walls for the treatment plant structure are typically 8" to 12" thick.

1. One part consists of Effluent Meter Structure, Filter and Chlorine Contact Tanks, that front the shoreline. It measures 156 feet long along the shoreline x 112 feet wide. Height of the structure varies from 16 feet for the Chlorine Contact Tank at the east end of the structure and the Effluent Meter Structure, to 19 feet at the Filter Tanks.

2. Second part consists of Aeration Basin and Aerobic Digester. It measures approximately 258 feet in east-west direction and 322 feet in north-south direction and the height of 21 feet.

D. HEADWORKS BUILDING

Headworks Building is a multi-level concrete framed structure, approximately 84 feet long x 42 feet wide x 23 feet high. Rear portion of the building, fronting the ocean, is an enclosed elevated structure with metal siding and roof.

DESCRIPTION OF BUILDING/STRUCTURE

BUILDING/STRUCTURE	LENGTH (DIAMETER)	WIDTH	HEIGHT	EXIST. GRADE
SLUDGE HOLDING TANK (S)	(31'-4")	-	11.5'	+10
OPERATIONS BUILDING	168'	40'	20'	+13 (max)
CENTRIFUGE PLATFORM	45'	23'	9'	-
EFFLUENT METER STRUCTURE FILTER & CHLORINE CONTACT TANKS	156'	112'	20'	+9.8
SECONDARY CLARIFIER AERATION BASIN & AEROBIC DIGESTER	258'	322'	21'	+9.8
HEADWORKS BUILDING	84'	42'	23'	+5.8 (min)

IV. ANALYSIS OF STRUCTURES AND DISCUSSION

Analysis of concrete structural members was performed, using working stress method. Calculations were increased by 1.33 factor or re-analyzed with strength method when the results were marginal.

A. SLUDGE HOLDING TANK

1. Elevation at the top of the wall for the tank is +21.5, which is above the tsunami wave height of 20.1 feet from MSL, predicted as the design 100-year tsunami height.

2. Bottom of footing extends 3'-6" below the existing grade, compared to the computed scour depth of approximately 3' below existing grade. Therefore, footing will not be undermined by the tsunami forces.

3. Resistance against overturning with a safety factor of 1.5 is adequate for both tanks. However, the tank does not meet the requirements for sliding resistance, if the tank is empty.

B. OPERATIONS BUILDING

1. Finish floor elevation of the slab-on-grade on a fill is at +15.0. Sheet metal siding 20 feet high surround the building. Bottom of the perimeter building wall footing is founded at elevation +12, which is 2 feet above the surrounding pavement elevation of +10, located minimum 15 feet from the edge of the building. Adjacent grade steps down about 2 feet from the finish floor of the building. As the slope is mainly protected with gravel fill at the surface, the first one foot was ignored as a protection from the scour. On the basis of the Dames & Moore report regarding the structure constructed on fill, resistance against scour is considered marginal at best and the building foundation may be susceptible to scour.

2. If the scour exceeds the depth of the building foundation and undermines the footing, the buoyant force will cause the slab-on-grade of the building to crack.

3. Tsunami wave force will cause the building to slide as well, although it will not topple the building.

4. Metal superstructure portion of the building is not expected to offer any protection against the tsunami wave force. Therefore, the elevated Centrifuge Platform within the building is assumed to take the full blunt of the force of the tsunami wave. Under this scenario, the wave height of +20.1 will not reach the floor elevation of the platform set at + 24.0. Assuming that the footing embedded 2'-6" into the fill material will not be undermined by scour action, the overall stability of the platform against overturning and

sliding is adequate. However, it should be noted that the overall stability of the building against sliding is deficient, and therefore, possibility of the platform sliding with the building exists. The pier reinforcement is adequate to resist the tsunami wave force. Assuming that the tsunami water will pass through under the pier footing and introduce buoyant force on the pier footing, the footing is adequate to resist such forces.

C. EFFLUENT METER STRUCTURE, FILTER AND CHLORINE CONTACT TANK, SECONDARY CLARIFIER, AERATION BASIN AND AEROBIC DIGESTER

1. Effluent Meter Structure, Filter and Chlorine Contact Tank

a. Floor elevations of Effluent Meter Structure at +20, Chlorine Tank at +16 and Filter Tank at +19 fall below the 100-year tsunami wave height of +20.1. Therefore the wave will overtop these tanks.

b. Scour depth of 3.1 feet will undermine the tank's exterior wall footing at the Filter Tanks area where the bottom of the footing is embedded only 1 foot below the existing pavement.

c. Overall stability of the tanks and meter structure, connected to the tanks, against overturning and sliding is adequate.

d. Because of the absence of cross walls to provide lateral support at the 16-foot high Chlorine Tank area and the Meter Structure, the wall must be designed as a cantilever member with maximum bending moment at the base. Analysis indicates that the reinforcing steel for the 12" thick exterior wall is deficient and will fail in bending as the result of the tsunami wave force.

The exterior wall for the 19-foot high Filter Tank is structurally adequate to resist the tsunami wave force.

2. Secondary Clarifier, Aeration Basin and Aerobic Digester

a. Floor elevation of the treatment plant containing these tanks at +21 will be above the tsunami wave height of +20.1.

b. Calculated scour depth of 3.1 feet will undermine the footing, embedded only 1 foot below the surrounding pavement elevation 0f +9.8.

c. Overall stability of these tanks against overturning and sliding is adequate.

e. The exterior wall 8" thick is adequate.

D. HEADWORKS BUILDING

1. Floor elevation of the elevated concrete floor area enclosed by sheet metal siding and roofing is at +18.17. Top-most platform for comminutors is located at elevation +23.0. Elevated grit chamber is located at elevation +9.5. Tsunami wave will reach all the levels, except for the top-most platform, housing the comminutors.

2. Individual concrete column and wall footings along north side of the structure are founded at elevation +3.5. Calculated scour depth of 4.3 feet will undermine these individual footings.

3. The 12" thick lower concrete wall, separating the enclosed building from the open platform, and the 12" square exterior columns along north side of the structure, are not reinforced adequately to resist the wave force. The slab at the enclosed building is not adequate to resist the upward force of the tsunami wave force due to insufficient top reinforcement.

4. Overall stability of the structure against overturning is considered adequate. However, the structure does not have adequate self weight to prevent sliding at the base.

5. It is expected that the metal siding over the platform at elevation +18.17 will not be able to resist the lateral load of the tsunami force. Because of the proximity of the base of the pre-engineered steel framing to the top of the wave, the shell of the metal building may survive the wave force, provided the existing lateral bracing system remains intact without damage.

V. CONCLUSIONS

Based on the analysis, following conclusions may be derived:

SLUDGE HOLDING TANK (SMALL)

OVERALL STABILITY	
OVERTURNING	Adequate
SLIDING	Adequate if full, Deficient if empty
FLOTATION	Adequate
SCOUR	Footing depth ok
MEMBER ADEQUACY	Walls are adequate

OPERATIONS BUILDING

OVERALL STABILITY	
OVERTURNING	Adequate
SLIDING	Deficient
FLOTATION	Possible damages to slab on grade
SCOUR	Possible footing undermining
MEMBER ADEQUACY	Metal siding and building members are not adequate

CENTRIFUGE PLATFORM (WITHIN OPERATIONS BUILDING)

OVERALL STABILITY	
OVERTURNING	Adequate
SLIDING	Adequate (provided building does not slide)
FLOTATION	Adequate
SCOUR	Possible footing undermining
MEMBER ADEQUACY	Adequate

EFFLUENT METER STRUCTURE, FILTER & CHLORINE CONTACT TANK

OVERALL STABILITY	
OVERTURNING	Adequate
SLIDING	Adequate
FLOTATION	Adequate
SCOUR	Undermining of wall footing along 19' high north wall
MEMBER ADEQUACY	Wall 16' high not adequate

SECONDARY CLARIFIER, AERATION BASIN & AEROBIC DIGESTER

OVERALL STABILITY

OVERTURNING	Adequate
SLIDING	Adequate
FLOTATION	Adequate
SCOUR	Undermining of footing
MEMBER ADEQUACY	Wall adequate

HEADWORKS BUILDING

OVERALL STABILITY	
OVERTURNING	Adequate
SLIDING	Deficient
FLOTATION	Adequate
SCOUR	Undermining of footing
MEMBER ADEQUACY	A 12" wall not adequate. The 12" square exterior columns not adequate. No slab top rebars at enclosed bldg floor - not adequate to resist uplift forces. Metal building enclosure is not adequate.

Deficiencies likely to produce most damages to the structures will be the lack of embedment of the perimeter footing and the dead weight that will result in undermining of the foundation as well as the movement of the structure itself and the eventual collapse of the building. Exterior wall and the columns are not adequate to resist the tsunami forces.

VI. RECOMMENDATIONS AND ESTIMATED RANGE OF REPAIR COST

Following recommendations are submitted with approximate range of repairs:

A. Sludge Holding Tank

1. To rectify the sliding deficiency of the existing empty tank at the time of the tsunami, more weights must be added either by filling the tank or by thickening the wall perimeter. Assuming adequate preparation time is available for the County Public Works personnel before the tsunami arrival from the more probable far source earthquake, Standing Operating Procedures should be established for the small sludge holding tank to be fully filled. If the County requires protection from the less probable major tsunami from the near source earthquake, thickening of the tank wall should be considered.

2. It is estimated that a total wall thickness of 3 feet with appropriate perimeter footing will be required to add enough weight to provide minimum safety factor of 1.5 against sliding. Cost of strengthening (Between $100,000 to $300,000 per tank) is considered moderate.

B. Operations Building

1. Complete reconstruction of the building is considered the only viable means to withstand the forces of the design tsunami height. The task is considered major undertaking (More than $2,000,000).

2. If the loss of metal framed superstructure can be operationally tolerated to preserve the structural integrity of the building floor slab and its foundation, recommend that the new perimeter concrete curb wall located at the base of the building about 15 feet away be constructed with its foundation extending down 3'-6" below existing roadway grade. Existing gravel finish between the curb and the building should be concreted to provide for additional protection against scour for the building foundation. Cost of improvements is considered moderate (Between $300,000 to $600,000).

C. Centrifuge Platform (Located within Operations Building)

1. Should the Operations Building remain in the present location with some improvements to strengthen the foundation to protect against scour, no significant work modifications would be required.

2. Although design tsunami height is lower than the present platform elevation, protection from possible damages to the equipment from the floating debris should be considered. Recommend that the more durable guard railing, particularly along north and east sides of the platform, be installed to replace the existing pipe railing, consistent with operational needs to keep some areas open for mounting and dismounting equipment. Cost of the improvement is considered minor (Less than $100,000).

D. Effluent Meter Structure, Filter & Chlorine Contact Tanks, Secondary Clarifier, Aeration Basin and Aerobic Digester

1. In order to abate the undermining of foundation due to scour action and to strengthen the exterior wall member of the tank structure, recommend that the 16' high exterior wall of the structure along north, east and south faces of Chlorine Contact Tanks and Effluent Meter Structure be thickened approximately 6" to new width of 18". It is also recommended that the foundation along north exterior wall of Filter Tanks and along north and west exterior walls of Secondary Clarifiers bed extended minimum 3.5' below the existing grade, below the calculated scour limit.

2. Strengthening and foundation extension is considered moderate undertaking (Between \$300,000 and \$600,000), from the standpoint of cost expenditure.

E. Headworks Building

1. Deficiency in column capacity and undermining of column foundation due to scour action may be corrected by increasing the size of the column and increasing the fill over the entire ground floor to provide adequate depth to existing footing to prevent tsunami water from penetrating below the structure foundation, respectively. Equipment at the ground level may be elevated or provided with separate concrete enclosure footing.

2. Sliding deficiency of the structure, as well as undermining of wall footing along south and west walls may be corrected: 1) By adding exterior concrete buttresses along the existing column lines with continuous footing tying them together and anchored to the foundation with mat type footing thick enough to provide adequate weight; 2) By providing 30" diameter drilled piers 15' deep at about 8' on centers.

3. Deficiency in elevated slab located below the design tsunami wave height may be corrected by adding a layer of concrete topping with reinforcing steel to provide negative moment capacity.

4. Existing metal building shall be removed. In its place, additional concrete wall shall be constructed to elevation above the design tsunami wave height. New metal building shall be constructed on the elevated concrete wall.

5. Extensive modification and strengthening of the Headworks Building is considered to be a major undertaking and estimated to cost more than \$1,000,000.

Although damages from the floating debris above the design tsunami height have not been factored in to the repair costs, possibility of such damages must be addressed during the repair planning stage.